allotrope

One laboratory | Different forms

Volume 1 | Issue 3 | July - Sept 2024

Catalysing Innovation

Research to Revenue: The journey of Sciencepreneurs

- In conversation with Scientist-Entrepreneur, Dr. V Premnath
- Efficient, durable, and scalable filters for separating pharmaceutical solvents
- Innovating Energy Solutions in a Net-Zero Future
- Global Conclave on Plastic Recycling and Sustainability (GCPRS 2024)

EDITORIAL

In recent years, there has been a significant increase in the number of science and technology-based start-ups in the country. Several researchers are keen on translating their PhD work into commercially viable technologies by launching their own companies. A passionate urge to create an impact by utilizing research competencies enables them to overcome challenges on the arduous journey to commercialization. Many national schemes and policies have helped catalyze the transition from lab to market. The proximity of a conducive ecosystem for deep-tech start-ups to an innovation-driven research organization acts as a game changer in this journey.

The third issue of Allotrope begins by describing the journey and challenges faced by such Sciencepreneurs. These are scientists whose start-ups have emerged as spin-outs based on technologies developed at CSIR-NCL. Following this is an interview with Sciencepreneur, Dr. V Premnath who heads NCL Innovations and the on-campus incubator Venture Center. A few path-breaking research and technology-based stories of the quarter are also highlighted. The readers would also get a glimpse of technologies licensed, MoUs signed, trainings, lectures, outreach, and student activities during this quarter.

Through this magazine, we aim to bring out the latest updates from the laboratory by creating a pathway that will help the readers connect closely with us.

The theme of this magazine is based on the concept of allotropes. Like allotropes are different forms of the same element, NCL, apart from being a premiere research laboratory, also takes up different forms at times. It acts as a dynamic knowledge hub that shapes the upcoming technologies, a capacity-building center, a common meeting ground for industrialists, scientists, and policy-makers, and a Launchpad for early bird researchers. The theme-oriented, output–driven research of the laboratory is multifaceted too. This magazine gives an overview of the laboratory's ongoing research and technological innovations. It also represents the other forms of NCL.

Hope this special issue on Research-based Entrepreneurship turns out to be an interesting read for you.

PATRON

Dr. Ashish Lele

Director, CSIR-NCL

EDITORIAL

Dr. Nikhlesh Yadav

Head, Publication and Science Communication Unit, CSIR-NCL

Ms. Neha Kanase

Publication and Science Communication Unit, CSIR-NCL

LAYOUT AND DESIGN

Mrs. Manisha Tayade

Ms. Neha Kanase

CONTRIBUTORS

Knowledge Resource Centre/ Library

Intellectual Property Group

Technology Management Group

NCL- SDP

NCL- Technology Entrepreneurship Club

Others

Dr. V. Premnath

Dr. Manjusha Shelke

Dr. Anuya Nisal

Dr. Rajesh Gonnade

Dr. Vrushali Jadhav

Mr. Nitin Thorat

For editorial queries, email to- allotrope@ncl.res.in

DISCLAIMER

The primary intent of this magazine is for non-profit, research, education, and outreach purposes. The opinions and views in the articles belong solely to the authors, resource persons, and concerned scientists. The material used in this magazine is copyright-protected. Permissions are obtained from the respective content owners, wherever possible. Appropriate credits are provided to the owner and sources.

VOLUME 1 | ISSUE 3 | JULY - SEPTEMBER 2024

CONTENTS

INVITATION FOR ARTICLES

We invite your contributions for Allotrope in the following capacities:

Research stories

Explain your research/ ongoing experiment in a simplified manner

Science articles

Describe a contemporary science topic, a scientific concept, technology, or a scientist of interest.

Individual experiences

Write about your personal field research/ travel experiences, conferences, paper/ poster presentations, PhD journey, or others. Senior scientists and staff members are invited to write about their work experience and insights.

Visual narrations

Showcase your research or technology with the help of a schematic or a graphic. Photographs related to NCL are also welcome.

The word limit for writing stories and articles is 500 words.

Kindly send your entries to: allotrope@ncl.res.in

RESEARCH TO REVENUE: THE JOURNEY OF SCIENCEPRENEURS

Executive Summary

The Intellectual property generated within academic realms is an important source for deep-tech ventures. Technologies developed in an industrially-focused research hub generate a huge utility and market need. But scientists and PhDs cannot always wait for someone to come and buy these technologies from them. In a world of fast-changing science, this waiting period often lags and alters the intended outcome. Hence, researchers must identify and strategize ways to take their work to the market. Over the years, many researchers have turned into budding entrepreneurs, driving change by converting their processes to products. However, the journey from concept to commercialization is not easy. From understanding and making the technology work in a laboratory to running a business out of it, research-based start-ups have to withstand several challenges. However, it is a fairly possible and enriching journey that creates a firm impact at the end of the road and generates several opportunities on the way.

> *"If somebody hadn't thought of a car, we still would be aiming for faster horses. If there weren't any scale-ups, industries and factories would cease to exist. Foresight is the pre-requisite for progress and purposeful technology utilization. Building a high-end technology is one thing, but having a market for it is another."*

In recent years, there has been a significant increase in the number of science and technology-based start-ups in the country. Several researchers are keen on translating their PhD work into commercially viable technologies by launching their own companies. However such start-ups have to overcome several barriers before they materialize. Launching deep-tech ventures involves a multifaceted process: From identifying a research niche that addresses the right problem and the outcome of which has a market worth, to developing a viable technology that meets this need and fulfils the goal. Being scientifically convinced about an idea is important but convincing the stakeholders of its worth is crucial. This involves pitching to the investors, talking to potential customers, getting regulations, technology transfer, and patents in place, and building a sound team. Research Entrepreneurs have to keep themselves motivated and sail their start-ups through several challenges like scale-ups, market fluctuations, new policies, product quality issues, conflicts of interest, financial burn-outs, and so on. The proximity of a conducive ecosystem for deep-tech start-ups to an innovation-driven research organization is a game changer in this journey.

The conducive ecosystem

The right kind of ecosystem comes a big way in establishing start-ups: An ecosystem that facilitates and nurtures a start-up from the initial stage of ideation to a sustained outcome-driven execution. It should take care of the needs of a new venture and act as a support for its functioning. A crucial network of people and resources is needed for the growth, testing, and ultimately scaling up of innovative ideas. Dr. Premnath, founder of the Venture Centre, an on-campus business incubator hosted by CSIR-NCL

Dr. Anuya Nisal, founder of Serigen Pvt Ltd

calls this "An ecosystem that promotes innovation". Further, stating its significance, he adds, "It is important to have such an ecosystem so that if you get ideas, you are naturally surrounded by resources that enable you to take steps toward building your ideas into start-ups. And this is a crucial part of technology commercialization"

The lack of an ecosystem can also limit one's ambitions. To quote Dr. Premnath, "Many times, scientists have to reimagine their ideas and repurpose their research to make it viable in the available ecosystem". The need for such an ecosystem is what led to the formation of an incubator close to the research laboratory. Venture Center is a place to discuss ideas, build teams, talk to mentors and investors, work with collaborators, and conduct clinical immersion trials, market studies, regulatory affairs, and so on. It also houses a variety of skill sets and interdisciplinary research competencies. An incubation space plays a critical role in the establishment of start-ups pursued by researchers turned entrepreneurs. Additionally, schemes and initiatives that allow a scientist to spin off the research, catalyze the journey toward entrepreneurship.

According to Dr. Anuya Nisal, CEO of Serigen Pvt Ltd, the ecosystem at NCL and the Venture Centre played a big role in setting up her company. Serigen utilizes silk-based devices for medical applications. She was able to build innovation capacity for herself and her team with the help of mentors and a network of established entrepreneurs, accessible through this ecosystem. She was also able to build a skill set that was beyond the scope of her research capability, but very much needed in starting a new venture. This included financial intelligence, curating business plans, understanding IP and regulations, and so on.

Addressing the need and knowing your market

Entrepreneurs often jump into a new venture without getting their research in place. It is important to have the homework ready before taking that leap. The most important steps in starting a new venture are 'need identification' and 'market research'. Before deciding on commercializing a technology, it is important to identify what need it is going to address and which existing gap it is going to fill. For example in the case of Serigen, the basic principle is silk processing, but beyond that, somebody had to understand doctors' needs, make optimizations, and design and fabricate the device manufacturing accordingly. Conducting primary market research and understanding trends is another important step. The ultimate goal of any technology on the path of commercialization is to realize its end use in the market. Even before one starts working on something, a quick study into the current trends is useful.

If the need and the market don't exist, everything comes to a standstill. Product-market fit (PMF) is a concept in marketing and product management for businesses. The product is tried and estimated across several possible markets. Business comes around the market where it fits. This is similar to the 'lock and key' mechanism. At times, the product has to be reimagined after identifying the potential customers.

Dr. Manjusha Shelke, founder of Rechargion Energy Pvt Ltd states the importance of market research and need identification: "I began developing Na-ion batteries in the laboratory in 2015. Only when I launched my company, that's when I started thinking about factors like market research and the future of Na ion batteries. When we thought about incorporating the company, within a year, Na-ion battery was a buzzword!"

Dr. Manjusha now encourages her students to

have an understanding of the market right from the beginning of their research work. According to some entrepreneurs, the approach that young researchers should inculcate is to think about the impact that their work is going to create. Is the science or technology they are working on going to help solve a problem? If in the future the technology gets commercialized, then, who are the people who would be using it and would be willing to pay for it? According to Dr. Anuya, a 360-degree holistic view of the technology is needed for entrepreneurship. For a researcher, the science or the process is important. However, the investor looks at the technology very differently. He is more concerned about the number of end-users, returns and margin on the product, and so on. Whereas from the customers' point of view, they are interested in the cost and safety of the product. Accommodating all these perspectives is needed for an entrepreneur.

Sounds great, but what about the funds?

Funding is the most crucial, yet challenging aspect of a start-up. Structuring the company well, having a product-oriented approach, and defining the business goals play a big role in getting the investors interested. For high-risk ventures, long-lasting funding is needed. Insolvency, as referred to Dr Premnath is one of the major reasons why companies fail. Entrepreneurs must know ways to acquire funds, and carefully utilize and sustain them. Taking debts early on in high-risk ventures is unwise to do. The Venture Centre has an online database of all the available funding options for deep-tech start-ups. Dr. Premnath encourages students to make use of this database. Regular track-keeping of the various funding opportunities, schemes, and policies for start-ups could be a good exercise for someone interested in starting a new venture. Dr. Anuya also highlights the pivotal role played by the Biotechnology Ignition Grant of the Biotechnology Industry Research Assistance Council (BIRAC) at a very early stage of the start-up. BIRAC is known to have contributed significantly to catalyzing the Biotech and Medtech innovation in the country.

These high-risk ventures aimed at solving

Dr. Manjusha Shelke and Dr. Vilas Shelke, co-founders of Rechargion Energy Pvt Ltd

cutting-edge problems usually require huge capital and investment. Raising funds for new ideas is always a challenge for entrepreneurs. At every stage, the technology's worth has to be proved to the investors. To convince investors, an entrepreneur must have a strong conviction to develop the technology. The proposed technology's ability to solve the problem, ease and reproducibility of the methodology used, the market capacity of the product generated, and its edge over the current operational processes to address the same problem are some of the key aspects involved.

A team, either sails or sinks the start-up

Many entrepreneurs suggest that the team is what builds a start-up and is also one of the reasons for start-up failure. Many times people with different visions are forced to work together. In such cases, the role of the founder becomes crucial in driving everyone towards the outcome and appreciating the varied expertise onboard. Other times, a group of friends come together to form a company. Handling this too requires skill and clarity as earlier when the friends knew each other, there wasn't any transaction between them. Now, suddenly, they are stakeholders, aligned to a vision. The team members need to realize that the collective vision they are working to achieve is much bigger than the individuals involved. The benefactors of the outcome are not just one but many. The skill of an entrepreneur lies in dealing with such conflicts of interest and keeping the team together. Entrepreneurs must adapt to the changing

The NCL Innovation Park, a conducive ecosystem for research-based entrepreneurship

roles in a start-up and not lose sight of conviction every time they have to take on a new responsibility or handle a challenge. An entrepreneur should be able to embrace change, even if it is to be made in the technology at concern. Dr. Anuya calls this "being wedded to the problem you are trying to solve instead of holding on to the technology" In a start-up, it becomes exceedingly important to keep the team motivated and aligned with the founder's vision. Salary cannot be used as an incentive during the initial years of a start-up as it is usually less than what other well-established companies pay. However, being associated with a start-up right from its initial years enables holistic growth and helps inculcate a vast skill set. It prepares one to face and overcome unanticipated challenges. An interdisciplinary and resourceful team enhances the chances of success.

Pitches aren't presentations

Efficient pitching is critical in raising money for a start-up. It involves putting forward the business idea to the potential investors of a company. Unlike the usual academic presentations, where scientists and students describe their research work, pitches are more concise and lucid versions. Rather than focusing on the research work done to address the need, emphasis is given to the monetary outcome of the research and whether the need is getting addressed in an effective, reproducible, and secure way.

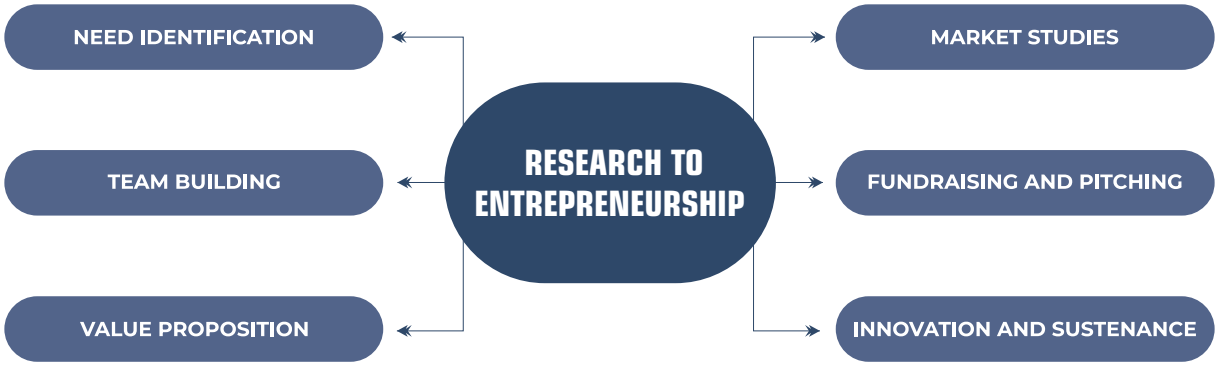
Dr Manjusha, while sharing her experience of talking to investors, recalls "As a scientist although I know how to give presentations and talk about my work at research conferences, pitching is an altogether different way. You have to get the investors interested in your company within 8 minutes. And usually, they aren't interested in the technicalities and details of your research, but in what you claim to offer through the proposed technology" Structuring the company in the right way for the investors to come, is the key. It is about understanding what the other person is interested in and responding accordingly. Rather than an in-depth explanation of the problem, it is much wiser to talk about the solution that one has to offer. Dr Anuya adds, "Your story has to be changed based on the audience. Over the years, I have learned to tone down the science and talk more about the benefits it is going to translate into. Being very precise about what you are going to say is important. I have done time-guarded practicing for pitches. For students, developing soft skills and effective communication in the initial phase comes a big way."

Concept to commercialization, a journey from processes to products

The journey towards commercialization is not straightforward. It has its twists and turns and often involves dealing with a number of challenges. The work in a lab is more process-oriented: developing the methodology to address a particular problem. Whereas commercialization involves a product-oriented approach: what is the final outcome or the end result that can be utilized? Both these require a slightly different skill set and infrastructure.

"Scaling-up and further optimization required a set-up beyond the academic realms".

For Dr. Majusha Shelke, it was important to optimize the batteries on a pilot scale as a step toward commercialization. She runs a start-up called Rechargion Energy Pvt



Ltd based on the Na-ion battery technology. Before launching her company, she worked for years on developing this technology as a scientist at NCL. "What worked in the lab never works in manufacturing. Everything works in a coin cell. The problem begins when you optimize it beyond, for higher applications," Dr Shelke says. Taking research from lab to market is never easy. One of the important aspects of this involves the scale-up process. Things pretty much work satisfactorily at the lab level. Acquiring results in a defined and calculated space is possible, although not easy. But, making the same processes work on a larger scale, at the pilot level becomes a mammoth task, let alone a technology! It is similar to solving the Schrodinger equation for the particle in a 1D box. However, applying the same for 2D and 3D boxes complicates the equation. Even making a simple reaction work at the pilot level involves a lot of quantification and optimization. Many times, the foundational chemistry needs to be modified and the product has to be re-engineered to get the property and scalability.

"A crucial aspect to understand here is to modify the process-oriented approach to the product-oriented one. The final product is what investors are interested in. For instance, if a chemical process is developed and the final product requires electronics engineering, then, that must be incorporated. One cannot remain restricted only to the chemical process. It's about bringing all the pieces of know-how together and creating the final product using an interdisciplinary and integrated approach", says Dr Premnath.

Another perspective that Dr Anuya brings is to see whether a particular technology is versatile enough to solve multiple problems. In the case of Serigen, the fundamental principle in all the 3 products is the same: extracting the silk thread, dissolving it to make a protein solution, and then processing it in different ways as per the required products. Each of the applications requires the product to have different properties. Bone filling requires it to be very hard, breast reconstruction requires it to be soft, and wound care requires it to be gel-like. So it's about utilizing the same raw material for different products.

Innovation and sustenance: grounds to reconcile

The beginning is usually very exciting: the idea is new and appears promising. But when one starts on the path of materializing the idea, that's when things don't appear that smooth. A lot of challenges come up, monotony sets in and the initial enthusiasm dies off. This is the phase where self-motivation plays a big role. The ability to be resilient even in a crisis-like situation makes an entrepreneur stand out. Keeping the innovation mindset alive throughout the journey helps in moving towards the goal. Talking to and interacting with founders who have walked down a similar path, can help ease the journey. It's about having an open mind and making room to accommodate different approaches to get the result. Not losing sight of the purpose-driven outcome and pursuing it with perseverance is important. A passionate urge to create an impact by utilizing research competencies enables entrepreneurs to overcome challenges on the arduous journey to commercialization. Young researchers are driven by a motivation for commercialization and enduring perseverance to see their research in the market.

Ms. Neha Kanase
ns.kanase@ncl.res.in

DIALOGUE WITH A SCIENTIST

Some people do not like to do things the conventional way. They dare to create their own vision and strive to see it materialize. ***Dr. V. Premnath*** *is a scientist-entrepreneur and founder of the Venture Centre. He is not merely satisfied by developing technologies but takes great pleasure in seeing them reach the market. He believes in utilizing research competencies for public welfare. Expanding his vision further, he supports other budding entrepreneurs in setting up their ventures. His work has significantly impacted national policies, the market economy, and people's lives.*

To start with, could you describe your days at IITB and later at MIT? How have they shaped your current outlook?

My interest in science has always been in utilizing technology for the good of people, especially health and rehabilitation. While I was in 12th grade, I took up both biology and mathematics. My uncle took me to meet several professionals to make a career choice. One of the areas that interested me was developing artificial limbs. I spoke to a few doctors, and many of them responded that they were preoccupied with treating patients and did not get much time for development work. That's how I decided to pursue engineering and was fortunate enough to join IITB!

In 1991, Jawaharlal Nehru Center for Advanced Research (JNCAR) announced a summer research fellowship. I applied for it and by chance was assigned at NCL to pursue my fellowship under Dr. Mashelkar. That was my first exposure to research. Dr. Mashelkar allowed me to work on a topic of interest. The work involved developing mathematical models for the controlled, sustained release of drug molecules through bilayer polymeric membranes. Our paper was published in the Proceedings of the Royal Society of London. During my fellowship, I also got a chance to learn about other polymer science topics and projects through Dr. Mashelkar's collection of research papers. For my PhD, I was applying to institutes in the US and got into MIT, thanks to the work with Dr. Mashelkar. MIT has always focused on utilizing technologies for problem-solving, specifically pressing problems. Many people who come to MIT don't just come to get a degree. They come to find cofounders and utilize the available network and ecosystem to take their ideas ahead! Over the years, Boston has built an ecosystem that promotes innovation, comprising scientists, technologists, regulators, market researchers, huge venture capital, experts, and stakeholders in various capacities. And that's a crucial part of technology commercialization.

At MIT I picked up my interest in developing materials for artificial limbs, knee, and hip replacement. My research advisor at MIT was working with a surgeon in Boston. Orthopedics represents to be 50% of the global medical implants market, so it was a very hot topic at that time. The work involved processing Ultra High Molecular Weight Polyethylene for the knee and hip implant. We addressed the issue of early breakage and wear in these implants to ensure a longer shelf-life and use-life. The strategy we used was very different from the traditional approach. Instead of increasing the hardness of the material to make it more resistant, we tried to process a softer material that could be equally resistant. Patents were filed, and the technology was commercialized very quickly. This was an important lesson about the importance of an innovation-supportive ecosystem for tech commercialization. The key takeaways were solving pressing problems and generating new knowledge while doing so, creating an impact out of your work, and working collaboratively to achieve bigger things.

What made you return to India, despite being in such a vibrant, innovation-driven ecosystem that you described?

I wanted to make a difference here. I returned immediately after my PhD with a vision of doing something different and impactful.

While at MIT, we started an initiative called Asha Education, which was continued in Pune for some time. We also started an Exciting Science Group for kids here. Raising money for this kind of work was relatively easy, but it couldn't be scaled up beyond a particular level. In this context, the idea of establishing a not-for-profit venture, that wouldn't be rapidly scalable, but the outcome that it will generate could be scaled up was conceived. The Venture Center, itself isn't rapidly scalable, but the start-ups it supports are.

What were the initial research projects that you worked on at NCL?

Initially, I worked on developing porous polyethylene biomaterials and implants. One of the doctors wanted us to develop a volume -filling implant for the orbital sphere of the eyeball. Typically, when a person's eyes are lost due to an injury, the doctors clean up the orbital sphere, fill it with an implant and put a fake eye on top of the void. Another project was to make cranial maxillofacial implants to fill out the voids caused by skull injuries. It was a niche application and the technology was developed by me and Dr. Ashish Lele who helped develop a novel, low-cost manufacturing process for porous polyethylene pellets to make the implants. The technology eventually made it to the market and led to the formation of Biopore Surgicals Pvt Ltd. At that time there was no provision for NCL scientists to start a company. We went through a process that taught us many things. We needed funding for animal studies and clinical trials, we had to understand the regulations, and so on. A good outcome was that a project student working with us got a job in the same company. So we transferred her along with the technology! As it is often said, “The best kind of technology transfer happens in a pair of shoes”. Only transferring technology isn't enough. It is important to build research capability within the new venture.

Why did you move away from an academic scientist's role?

For me, I wanted a bigger impact. Working on a technology for 4-5 years and then handing it to a company that would sell 10,000 pieces of it wasn't interesting enough for me. In 2005, I was on a sabbatical to the UK under a program run by the London Business School and the University College London for training in building scientific enterprises while also engaging with an academic spinoff from the University of Cambridge. This was the time when technology commercialization was pacing up at Oxford and Cambridge. They had started the Begbroke Science Park and Oxford Innovations at Oxford and the Cambridge Enterprise and Cambridge Science Park at Cambridge. It gave me the idea to start something on similar lines in our country. Around the same time, discussions were going on between CSIR, led by Dr Sivaram, and DST for starting an incubator at NCL. A proposal was put forward through the Business Development group of NCL. When I returned, I went to pitch the proposal and they agreed to fund the incubator company.

How did the on-campus incubator, Venture Centre come into existence? What was its Agenda? In the context of Technology utilization, what were the routes to market being examined at NCL, and what role did the Innovations and IP group play?

The company came up in 2007 and was formally registered as the Entrepreneurship Development Center (EDC). The goal was to focus on new ventures and science-based start-ups that will utilize technologies to solve problems. It was set up as a separate organization, open to all.

Around the same time, NCL Innovations as a Resource Center of NCL was set up with the vision of commercializing technologies. In 2008, the IP Group was established. It was a crucial step for tech-based commercialization as without IP, attracting the interest of investors and licensees is difficult. The impact of setting up this group was visible: by 2013, NCL was the largest non-profit patent filer in the country. Moreover, we had actively made sure that the younger scientists were filing. So these two groups although with different purposes, complemented each other. While the innovation team identified the routes to the market and decided the investment worth of technology, the IP Group helped to protect ideas and ensure ownership rights. One of the routes to market is a start-up, and that is what Venture Center does. We experimented with other routes as well at NCL. One of them was a Public-Private Partnership (PPP) that we explored for Fuel cells. We tried to see if Reliance would be interested in developing the entity. During Dr. Mashelkar's time, schemes were initiated to develop such entities. A separate company could be set up based on a research project. When I worked at Cambridge, next to our office was a collaborative center of Rolls Royce and Cambridge for making Ni alloys for engines. So we wanted to create a similar model here. We also experimented with the PPP model for NCL's project on

developing security features in RBI currency. There is still a rupee lab at the Venture Center! Another route that we experimented with was establishing a company called the CSIR-Tech. The company was set up to accelerate tech transfers for all the labs under CSIR. It ran successfully for a few years, but the returns from tech transfers were not high enough to cover the costs. This initiative was a first of its kind in the country and was much ahead of time. It was a for-profit entity, within a not-for-profit organization utilizing technologies for commercialization with the investors on board. This was inspired by Imperial innovations started by the Imperial College London that raised money from the Alternative Investment Market of the London Stock Exchange to commercialize technologies.

Could you describe the ecosystem of the Venture Center?

Venture Center supports new ideas, especially from young people. An idea is never criticized and we never say it is impossible. We listen to them, mentor them, connect them to similar business networks, and help them raise money. Guidance is given to structure the company properly so that the investors can come. The infrastructure at the Center hosts office, labs and meeting spaces for entrepreneurs to work and talk to stakeholders, investors, potential customers, and other founders. We also provide clinical and on-site immersions to witness and understand the actual problem. This requires a well-established network that we've tried to build over the years. We also gradually enhance the start-ups for investor readiness and global competitiveness. We have experts doing the regulatory pathways for start-ups. IP is another crucial aspect that is taken care of through a team that handles patents, trademarks, and copyrights. An ISO-certified clean room for medical products is available and open to many companies. Other facilities include the Proof of Concept lab spaces, plug and play labs, physical and digital prototyping capabilities etc

Alongside this, we have also been involved in shaping policies like the National DeepTech Start-up Policy, the National Science and Technology Innovation Policy with DST, and so on. We have also drafted national scheme documents like Biotechnology Industry Research Assistance Council's (BIRAC's) Biotech Innovation Grant scheme and the NIDHI-Entrepreneurship in Residence program to nurture budding entrepreneurs.

What goal has the Venture Center set for itself?

So by 2032, we aim to demonstrate a cluster of 100 large-scale, impactful inventive start-ups. We have already worked with about 800 start-ups till now. 85% of our incubated start-ups are still active. In high-risk, high-reward ventures, the success rate is usually low. Hence we have to work with 1000s to get impactful 100s. One of our key goals is to work with 1000s. Above all, 30% of the start-up founders are women entrepreneurs, and they are doing very well.

How do students inculcate this kind of attitude early on in their careers? To identify a niche area and think of starting their ventures.

I believe that everyone should have their own story. People shouldn't follow somebody else. Most scientists come into science because they want to do something useful and make an impact. Figuring out what you want to do is important. Different people might have different perspectives and orientations. For me, the ultimate satisfaction is to see the technology being used for betterment. For others, it might be something else. I just want people to think of some of these possibilities. That's what we do through the NCL-Technology and Entrepreneurship Club activities for students. We give them our perspective and show them the ecosystem that can make things possible. The 'Innovation and Enterprise Lecture series' for students and scientists gives them a chance to hear from role models, and interact with and learn from entrepreneurs. Maybe a few students might get interested, and even fewer might act in that direction and become successful. It's not everybody's cup of tea! It's all about answering what you should be doing in your life and why. What do you believe to be valuable and important? Science has to be done anyway, it just depends on how you do it.

So for those interested in taking this path, what are the pitfalls they should look out for? Because concept to commercialization is not an easy journey.

Of course, it is not an easy journey; moreover, it is also very lonely. Because initially, not many people believe in your idea. They might make fun of you. You may have to work for a long time without any results. So you have to sail through all these challenges and focus on your goal and the outcome. This path is for people who can be resilient throughout the journey. One has to have a vision of this world and be convinced about the importance of what they are doing. For instance, Alexander Graham Bell invented the telephone while he was a professor at Boston University. Initially, people thought of it as a toy to talk from one room to another and nobody placed a value on it. But, he was convinced that it had value. Western Union wanted to buy the technology from him, but he refused the money and started his own company. That's how

Bell Labs originated, which is now AT&T. So those who want to become entrepreneurs should know that there are mechanisms available to turn their idea into a business. But if someone has a very rosy notion and thinks of it as an easy road to making money, then that's not the right approach. A tremendous amount of risk, hard work, and personal motivation is involved. Start-ups are not about taking undue risks. They're about assessing and managing risks carefully. You have to be resourceful and aware of the risks on your way and try to mitigate them.

You have mentored several start-ups. What are the main challenges that they go through? And how do you pitch in to overcome these?

The top reason why companies and start-ups fail is because the need that they define doesn't exist. Hence, need identification is important. The second reason why most start-ups fail is the team. Disputes arise, and changes need to be accommodated in the team. The third reason is funding. Entrepreneurs must know how to acquire, utilize, and sustain funds. Many companies fail because they run out of cash, which is known as insolvency. So at the Venture Center, we teach them how to manage funds. We have 5 seed funds at the Center and our team invests in start-ups. There are 65+ investing companies in Venture Center. Our team looks into their annual accounts and guides them.

How does entrepreneurship work for NCL scientists? Do they approach you, or do you identify potentially viable technologies from the laboratory?

NCL spin-outs are a special class of companies that are based on NCL technologies developed by scientists and students. A sub-class is one wherethe scientist participates in conceptualizing and creating the company after getting special permission from CSIR headquarters to start the company. Till now, we have done about 11 spin-outs from NCL. Both the tech transfer team and the founding team play a key role in getting the funders or investors interested.

At one time, NCL Innovations was surveying all the technologies at NCL. The selected ones were taken to DST. We got a grant to do the market research. This exercise was carried out for about 50 technologies. An agreement between NCL and VC began, and it was called the Lab2Mkt Agreement. Out of the 50 technologies, 6-8 were eventually taken for spin-outs. We would pitch business stories to funders about the scientist's capabilities, know-hows, products, and the potential market. Eventually, we had the money, business story, team and technology lined up and got permission to form a company through the Scientist Entrepreneurship Scheme (SES) of CSIR. The founders included scientists and ex-students.

Right now we are evaluating 3 start-ups from NCL. Two of them are scientists. The third one is a student to whom we have given a fellowship to initiate a start-up. But we no longer have the DST fund. So we are identifying different ways. So far, 15-20 SES applications have gone from NCL. There has been proactive participation from scientists as well as students at NCL.

You write a blog on versatile and not-so-conventional topics. How do you align this with your current responsibilities and passion?

It so happened that, many students would ask me the same questions. So I started writing those answers through blog articles as a one-place destination for them to read! For instance, one of my blogs addresses the question of people wanting to be rich, nothing wrong with that. Some of my blogs address the question of making career choices. There are also lots of online videos from the Venture Center as Atal Innovations' partner for deep tech ventures.

There are also 2 books published by VC, one is called CanDid: 15 Stories of India's Upcoming Science-based Entrepreneurs and another is an AIM Prime Playbook. One of the regular activities at VC is interacting with professionals to give them a sense of innovation. Recently, we invited a group of nurses and showed them several inventions made in the past by nurses. It was an inspiring session for them.

According to you, how important is science communication in an innovation-driven ecosystem?

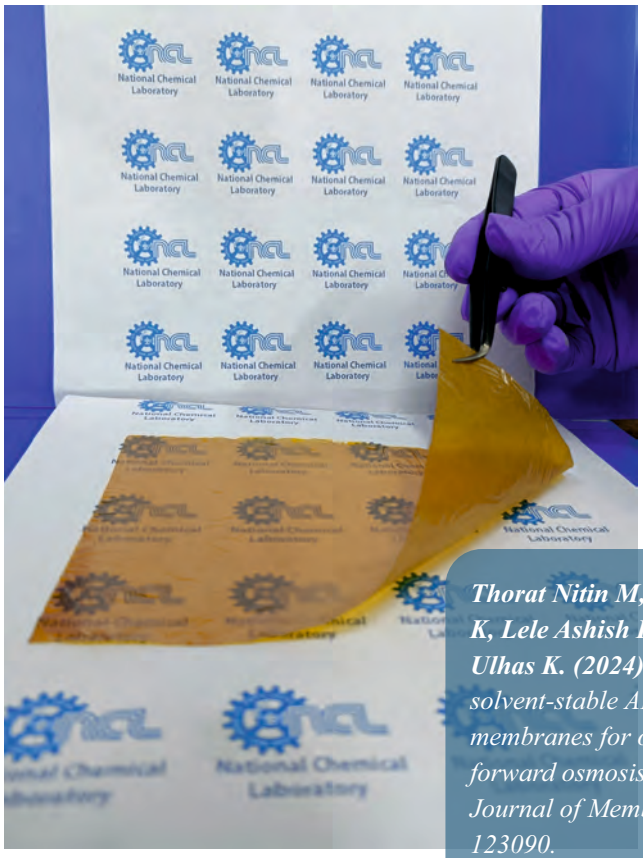
Science communication is very much needed. Topics like history and philosophy of science play a big role. The stories of early founders like PC Ray and Shanti Swarup Bhatnagar need to be communicated. It is crucial to communicate the thinking and ideology of role models. Even if we talk about rigorous logical thinking for analyzing data in the case of PhD students, they should be shown examples of others who have done it. It is more about conveying the possibilities and putting things in perspective. It's about having the right foresight while they are still studying. Communicating stories that will help foresee the future is important. Communicating the importance of science-based technology and innovation inspires many to work on solving pressing problems of the day.

As you mentioned, everything is exciting when an idea is new. But, asone moves towards execution, boredom sets in. So, in this context, being innovative even in the

monotony and sustaining what you have started, how do you reconcile these two?

According to me, it is your passion for the endpoint that keeps you going. Many people come up with ideas. While they start executing, they might fail. Now, when they fail for the first time, most of them start thinking about other alternatives. But only a few of them reconsider their original idea and change execution. This is what differentiates entrepreneurs from others. I think that their motivation for the endpoint and seeing their idea manifest helps them overcome the monotony. But some people enjoy the process as well. For example, a musician, enjoying the process of perfecting a music piece. The endpoint might be the show that he will put up. Some enjoy the audience's acknowledgment others enjoy the journey of creating that piece of music. Both are important. The endpoint people have a vision and they drive their team with that vision. I have seen some extremely resilient entrepreneurs. If they are low on funds, they'll reduce their expenses, keep at it, do something else, and then suddenly come back. Not giving up is important. Someone said that the trick in entrepreneurship is to stay alive long enough for mother luck to come to you! Many entrepreneurs will tell you that there was a point when they were almost dead, but then the tables turned because they didn't give up. Even at Venture Center, we have gone through several challenges. But seeing the successful start-ups come up is very satisfying. And those who don't succeed are also doing interesting things. The start-ups that we are working on, might fail, quite possibly, so what? We have given it a good shot. We have got the investors interested and set the ball rolling.

FEATURED RESEARCH



Efficient, durable, and scalable filters for separating pharmaceutical solvents

Thorat Nitin M, Valvi Suresh V, K, Lele Ashish K, & Kharul Ulhas K. (2024). *Thin, flat sheet, solvent-stable ABPBI-based membranes for organic solvent forward osmosis (OSFO). Journal of Membrane Science, 123090. https://doi.org/10.1016/j.memsci.2024.123090*

The process of synthesizing drugs and medicines in pharmaceutical industries utilizes several organic solvents. Due to the excessive use of such solvents in the reaction, the final product obtained, needs to be separated out from the solvents used. This is often done by heating the mixture, which vaporizes the organic solvents, thus, concentrating the product. However, the Active Pharmaceutical Ingredient (API) which is a crucial component of any drug, is heat sensitive. So, due to excess heat, it loses some of its activity and thus affects the drug potency. Hence, an efficient system is required that does not impact the API and also helps separate the solvents.

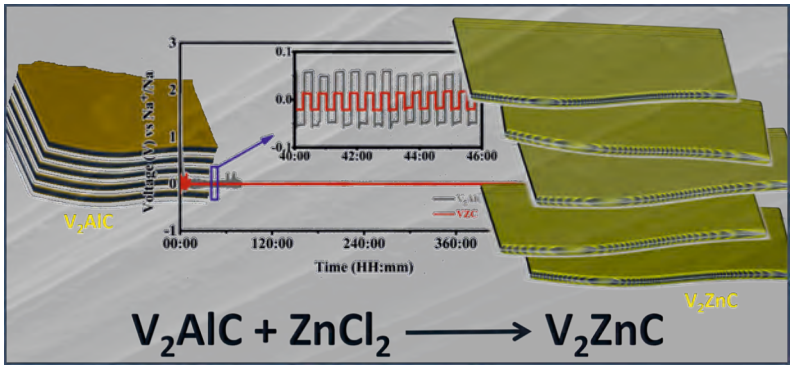
In recent years, methods like 'Organic Solvent Forward Osmosis' have been used. Osmosis is a passive process in which solvent molecules move from a region of high solvent concentration to a region of low solvent concentration. Here, the drug mixture acts as a region of high solvent concentration, from which the solvents move out. This is done by the use of certain membranes that act like filters. Using these filter-like membranes, the solvent gets separated and what remains is the final drug product.

Such flat-sheet membranes to separate solvents at room temperature have been developed at the Polymer Science and Engineering division. These membranes are synthesized using a material called poly (2,5-benzimidazole), commonly known as ABPBI.

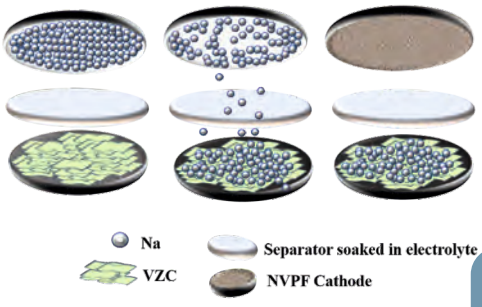
These have been tested for 24 hours in the laboratory and are reported to give a 100% product recovery from the solvents. The novelty of the membranes developed at NCL is that they are scalable and stable for a long period. Other membranes, reported earlier in the literature degrade in a short while but this one stays stable for 8 hours at the lab scale. Additionally, the membranes synthesized at NCL have an average thickness of 17 microns, which eases solvent separation.

Mimics of the actual pharmaceutical compounds were made to optimize the separation efficacy. These are called Model Organic Compounds or MOCs. Some MOCs used for separation include p-nitrophenol, o-nitroaniline, Methyl red, Malachite Green, Rhodamine B, etc. The membrane has worked successfully in isolating these compounds from the solvents. The durability of these membranes has been tested using harsh solvents like methyl and ethyl hydroxides, Dimethyl Sulfoxide, Acetonitrile, Dimethyl formamide etc. For application purposes, this membrane has also been tested in fuel cells. A fuel cell generally has a very harsh environment of about 200°C temperature, and a pH of 2-3. The membrane is found to be stable even at such a high temperature and acidic pH.

A promising active host material for Sodium battery technology



Dr. Manjusha Shelke's lab at CSIR-NCL has been working on developing Na-ion batteries for a long time. These are considered as viable alternatives to the conventional Li-ion batteries. The preliminary step in battery production involves synthesizing an efficient host material. Traditionally, hard carbon is used as an anode in sodium-ion batteries. But, sodium metal can also be used as an anode as it gives a high specific capacity of 1165mAhg^{-1}. Sodium can be paired with high-capacity cathodes, such as sulfur or air to give a full cell having a higher energy. One of the most crucial steps in producing alkaline metal batteries is the formation of Solid Electrolyte Interface (SEI). It stabilizes the electrode and prevents it from coming in contact with the electrolyte. Sometimes, the bulging of the electrode due to excess of Na ions can break SEI. Hence, it is important to maintain its strength to avoid dendrite formation that eventually leads to short-circuiting and poor battery performance. Other thermodynamic and kinetic factors also lead to dendrite formation in these kinds of battery systems. One of the ways to overcome dendrite formation is to reduce the current density. But batteries need to be operated at a high current density. Hence, the team has worked on increasing the surface area of the host material so as to reduce the local current density. Dr Manjusha's student, Kundan Wasnik has deployed a scalable and efficient host engineering method to tackle this challenge. The sodiophilic host material developed is capable of attracting sodium ions. This helps in the uniform coating of sodium throughout the bulk thus preventing dendrite formation at a single point. In this work, the host material is modified using an alternate MAX phase.

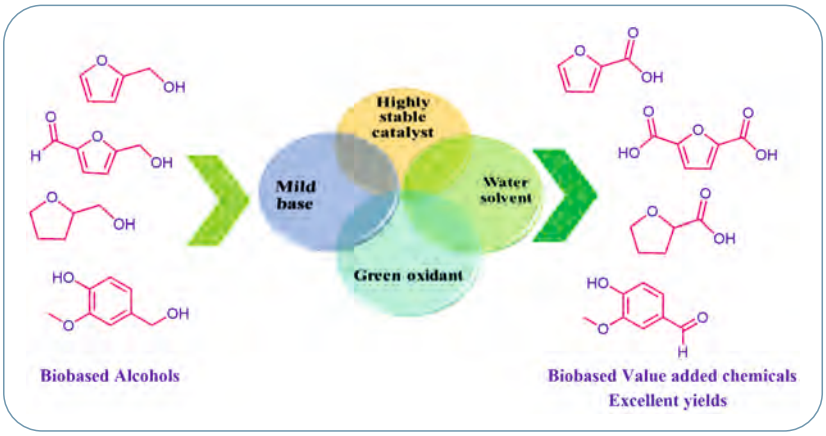


Wasnik, K., Patrike, A., & Shelke, M. V. (2024). Unveiling a Promising Active Host Material for Sodium Metal Anodes through V2AlC MAX Derivation. *ACS Applied Energy Materials. https://doi.org/10.1021/acsaem.4c01059*

MAX phases are layered materials made of transition metals coupled with carbides or nitrides. They possess metallic and ceramic properties. Vanadium Zinc carbide (VZC) is used as an alternate MAX phase in this work, where Zinc and Vanadium act as active sites for sodium deposition because of their sodiophilic nature. These active sites guide the movement of Sodium ions to avoid clustering. The MAX layer being highly conducting, efficiently distributes the charges even at high current density, thus suppressing dendrite formation. A patent has also been filed for this work.

This work has been tested in a proof-of-concept full cell. The Sodium-VZC anode was paired with a commercially available cathode, Sodium vanadium fluorophosphate, or $Na_3V_2(PO_4)_2F_3$ (NVPF). An average discharge capacity of 104mAg^{-1} was observed for 50 cycles at 0.1 C. The anode host material showed stability for 480 hours with a 99.9% coulombic efficiency for reversible Na plating and stripping.

A practical and scalable approach towards biomass-based value added chemicals



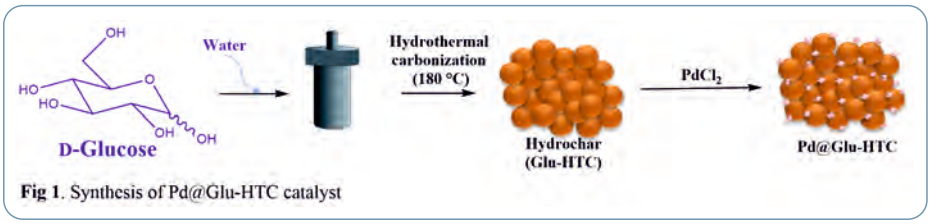


Fig 1. Synthesis of Pd@Glu-HTC catalyst

Kirdant, S. P., Bankar, S. R., & Jadhav, V. H. (2024). *Direct oxidation of alcohols to carboxylic acids using simple and economical Pd@Glu-HTC catalyst: Practical and scalable approach towards biomass based value added chemicals. Biomass and Bioenergy, 187, 107290. https://doi.org/10.1016/j.biombioe.2024.107290*

Sustainable catalytic transformation of bio-based alcohols to high-value-added fine chemicals is an important research topic. Direct oxidation of alcohols to acids is a commonly used transformation in many pharmaceutical, agro-based, chemical, and polymer industries. In today's era, renewable and sustainable feedstock gain importance as they can act as a substitute for materials derived from petroleum sources. Bio-based alcohols can serve as perfect candidates for the synthesis of industrially important chemicals as they can be easily derived from renewable and sustainable feedstock such as biomass.

Dr. Vrushali Jadhav's research group at CSIR-NCL has come up with a sustainable process to obtain these commercially viable carboxylic acids from direct oxidation of alcohols. Her students, Ms. Swapnali Kirdant and Mr. Shubham Bankar, have developed a simple yet efficient carbon-based catalyst derived from readily available biomass-derived glucose, making the catalyst and catalytic process green and renewable. Carbon material possesses mechanical strength and thermal and chemical stability. Another advantage of using carbon support was that the active phase could be recovered by eliminating the support by burning the carbon away. Carbon supports are also less expensive compared to other supports.

Hydrothermal carbonization of glucose was carried out in the first step to synthesize Glu-HTC support at lower temperatures in a simpler, greener, economical, and efficient manner, followed by the incorporation of palladium metal on the catalyst's surface in the second step. Pd@Glu-HTC was used for oxidizing commercial as well as bio-based alcohols. Around 16 different types of alcohols were oxidized using this catalyst. Some of these include value-added industrially important chemicals such as furoic acid (flavoring agent and preservative in the industry), 2, 5-furan-dicarboxylic acid (a monomer for 100 % fossil-free, recyclable polyethylene furanoate (PEF)), tetrahydro-2-furoic acid (used in drug production), etc.

This catalyst developed is efficient compared to the earlier catalysts reported in the literature. The reaction time was reduced alongside obtaining 92-99% yield and excellent selectivity of the desired products formed. The strategy used here required molecular oxygen as an oxidant, a milder base, and water as a solvent which made the process greener. The catalyst was also found to be reusable and stable for up to four runs without any loss in its catalytic activity.

Publications
(July- Sept 2024)

1. Patil, Abhijit Ramchandra; Marelli, Udaya Kiran, (2024), Integrating 3,4-Dihydro-2H-1,4-oxazine into Peptides as a Modification: Silver Triflate-Catalyzed Cyclization of N-Propargyl N-Sulfonyl Amino Alcohols for SPPS Applications, *Organic Letters*, 26, 36, *7584-7589*
2. Dash, Soumya Ranjan; Vanka, Kumar (2024), Taming XeO3 with Aza-Crowns: Computational Studies into σ-Hole Mediated Host-Guest Interactions, *ChemPhysChem, e202400302*
3. Lucier, Rosalind; Kamileen, Mohamed O.; Nakamura, Yoko; Serediuk, Sofiia; Barbole, Ranjit; Wurlitzer, Jens; Kunert, Maritta; Heinicke, Sarah; O'Connor, Sarah E.; Sonawane, Prashant D., (2024) Steroidal scaffold decorations in Solanum alkaloid biosynthesis, *Molecular Plant, 17,8 1236-1254*
4. Dangi, Abha; Qureshi, Tazeen; Chinnathambi, Subashchandrabose; Marelli, Udaya Kiran, (2024) Macrocyclic peptides derived from AcPHF6*and AcPHF6 to selectively modulate the Tau aggregation, *Bioorganic Chemistry, 151,1E+05*
5. Kargude, Radhakisan; Javaregowda, Bharathkumar H.; Palani, Sathishkumar; Singh, Anup K.; Krishnamoorthy, Kothandam,(2024), Shuttle Balance between Lithiophilic Functionalities Substituted on Conjugated Polymers to Improve Lithium-Ion Diffusion and Cycling Stability of Batteries, *Macromolecules, 57,16,7830-7840*
6. Rathod, Yugal; Natu, Varun, (2024) TiO2 spaghetti for sustainable future, *Matter,* 7,8
7. Kirdant, Swapnali P.; Bankar, Shubham R.; Jadhav, Vrushali H., (2024) Direct oxidation of alcohols to carboxylic acids using simple and economical Pd@Glu-HTC catalyst: Practical and scalable approach towards biomass-based value-added chemicals, *Biomass Bioenergy, 187,1E+5*
8. More, Devidas A.; Gayathri, P. R.; Thete, Kishor R.; Muthukrishnan, M.,(2024) Visible-Light Mediated C-3 Amination of Quinoxalin-2(1H)-ones via Electron Donor-Acceptor Complexation, *Asian Journal of Organic Chemistry, 13,8*
9. Vinodkumar, Ramavath; Nakate, Ashwini K.; Gamidi, Rama Krishna; Kontham, Ravindar, (2024) Ready Access to [5,6,5]-Trioxa-spiro and Fused Ketals via Ag-Catalyzed Cascade Annulation of 4-Pentyn-1-ols and Aldehydes, *Organic Letters, 26,34,7116-7121*
10. Nitin, M. Thorat; Suresh, V. Valvi; Ashish, K. Lele; Ulhas, K. Kharul, (2024), Thin, flat sheet, solvent-stable ABPBI-based membranes for organic solvent forward osmosis (OSFO), *Journal of Membrane Science*, 708, 1E+05
11. Kale, Someshwar B.; Patil, Tejaswini A.; Das, Utpal, (2024), Rongalite as a C1 Source: Sulfonylmethylation of Indoles with Aryl/Alkyl Hydrazides and Sulfinates, *Journal of Organic. Chemistry, 89,16,11347-11352*
12. Rupanawar, Bapurao D.; Bansode, Ajay H.; Suryavanshi, Gurunath, (2024), Hypervalent-Iodine-Mediated Base-Free Oxidative Olefination of Benzylic Amines to Access α,β-Unsaturated Ketones, *Synlett*
13. Karche, Ranjit S.; Bankar, Shubham R.; Jadhav, Vrushali H., (2024) Alternative synthetic route for the pharmacophore of anticancer agent: Triazolopyridazine derivative, *Tetrahedron Letter,146,2E+05*
14. Sharma, Himanshu; Vanka, Kumar, (2024), In Silico Discovery of a Neutral 2π Aromatic Silicon Aluminum Compound, *Organometallics, 43,14,1583,1592*

15 Talanikar, Aniket A.; Nagane, Samadhan S.; Wadgaonkar, Prakash P.; Rashinkar, Gajanan S, (2024), Aromatic (co)polycarbonates bearing pendant 2,3-dimethylmaleimido group based upon a new phthalimidine-containing cardo bisphenol, *Journal of Macromolecular Science Part A-Pure Applied Chem*istry

16 Ghuge, Gorakh Hiraman; Torris, Arun; Nair, Kiran Sukumaran, (2024) Biobased Reusable Nonisocyanate Polyurethane Hot-Melt Adhesives with Potential Chemical Degradability, *ACS Applied Polymer Materials*

17 Dash, Soumya Ranjan; Vanka, Kumar, (2024), Unveiling the Inverse Sandwich Complexes of XeO3: A Computational Exploration, *Inorganic Chemistry,* 63,29*,13585-13593*

18 Ingole, Kiran Balaso; Deshmukh, Shivdeep Suresh; Verma, Tushar Singh; Krishnamurty, Sailaja; Krishnamoorthy, Kothandam; Nithyanandhan, Jayaraj, (2024), Triazatruxene Amine Donor-Based Visible-Light-Responsive Unsymmetrical Squaraine Dyes for Dye-Sensitized Solar Cells, *ACS Applied Energy Materials*

19 Bhoite, Ashwini; Gaur, Neeraj K.; Palange, Megha; Kontham, Ravindar; Gupta, Vidya; Kulkarni, Kiran, (2024), Structure of epoxide hydrolase 2 from Mangifera indica throws light on the substrate specificity determinants of plant epoxide hydrolases, *Biochemical Biophysical Research Communication,733, 2E+05*

20 Wasnik, Kundan; Patrike, Apurva; Shelke, Manjusha V. (2024), Unveiling a Promising Active Host Material for Sodium Metal Anodes through V2AlC MAX Derivation, *ACS Applied Energy Materials,* 7,15*,6084,6089*

21 Kurian, Maria; Ranganath, Suresha P.; Vijayakumar, Vidyanand; Sivadasan, Sneha; Kurian, Rachna Maria; Badiger, Manohar V.; Kurungot, Sreekumar, (2024), F-Doped Nickel Cobalt Oxide-Carbon Composite Electrocatalysts Paired with Mechanically Robust Anion-Conducting Chitosan Membranes for Flexible and Rechargeable Zinc-Air Batteries, *ACS Applied Energy Materials,* 7,16, *7037-7054*

22 Talanikar, Aniket A.; Nagane, Samadhan S.; Wadgaonkar, Prakash P.; Rashinkar, Gajanan S.,(2024) Aromatic (Co)polycarbonates bearing pendant norbornenyl groups: Synthesis, characterization and post-polymerization modification, *High-Performance Polymers*

23 Walve, Vaibhav; Parakh, Piyush; Rajput, Umashankar; Mhase, Akash S.; Singh, Kirandeep; Deshpande, Aparna,(2024), Unveiling different structural orderings in Fe5-xGeTe2, *Physical Review B,* 110,7*,75119*

24 Wavhal, Aryan Anurath; Dilwale, Swati; Puthiyaveetil, Priyanka Pandinhare; Kakde, Navnath R.; Prakash, Medha; Kurungot, Sreekumar; Asha, S. K. (2024), High-Voltage Symmetric Supercapacitor Electrodes Via In Situ Synthesized Multiwalled Carbon Nanotube-Doped Perylenebisimide-Based Donor-Acceptor Conjugate Polymer P(PDI2OD-T2), *Journal Physical Chemistry C,* 128,31,*12808-12821*

25 Khonde, Nilesh S.; Said, Madhukar S.; Danve, Shivam S.; Kumar, Pradeep, (2024), Organocatalytic route to the enantioselective synthesis of syn/ anti-α-hydrazino-γ-fluoro alcohols, *Tetrahedron Letters,* 145,*2E+05*

26 Kandasamy, Prabu; Gawali, Sheetal; Venugopalan, Aswathy Thareparambil; Manikandan, Marimuthu; Mekala, Siva Prasad; Shelke, Ankita; Ajithkumar, Thalasseril G.; Bhatte, Kushal; Raja, Thirumalaiswamy, (2024), New insights into the composition and catalytic performance of VOx-Ga/γ-Al2O3 for the oxidative dehydrogenation of propane to propene, *New Journal of Chemistry,* 48,34*,15077,15087*

27 Shinde, Dipak Dattatray; Sharma, Anjali; Dambhare, Neha V.; Mahajan, Chandan; Biswas, Arindam; Mitra, Anurag; Rath, Arup K., (2024), Synthesis and Processing Strategy for High-Bandgap PbS Quantum Dots: A Promising Candidate for Harvesting High-Energy Photons in Solar Cells, *ACS Applied Materials and Interfaces, 16,32,42522-42533*

28 Kumar, Rohit; Tewari, Tanuja; Chikkali, Samir H.,(2024), Iron in Organometallic Transformations: A Sustainable Substitute for Noble Metals, *ChemCatChem*

29 Shabade, Anand B.; Singh, Rahul K.; Gonnade, Rajesh G.; Punji, Benudhar, (2024) Manganese-Catalyzed Chemoselective Direct Hydrogenation of α,β-Epoxy Ketones and α-Ketoamides at Room Temperature, *Advanced Synthesis and Catalysis,* 366,15*,3338-3345*

30 Bajpai, Himanshu; Nivedhitha, Thazhath R.; Dais, Elsa; Kanungo, Subhashree S.; Gopinath, Chinnakonda S, (2024), Oxidative and selective C-C cleavage of glycerol to glycolaldehyde with atom-like Cu on Cu-TiO2: Photocatalytic water reduction with concurrent glycerol oxidation in sunlight, *Journal of Catalysis, 437*

31 Parmar, Muskan; Mukhopadhyay, Sanchayita; Mondal, Ritwik; Nayak, Bhojkumar; Dargily, Neethu Christudas; Kotresh, Harish Makri Nimbegondi; Vinod, Chathakudath Prabhakaran; Ottakam Thotiyl, Musthafa, (2024), Synergistic effects of the substrate-ligand interaction in metal-organic complexes on the de-electronation kinetics of a vitamin C fuel cell, *Dalton Transactions,*53,32*,13384-13393*

32 Chandanshive, Amol C.; Gonnade, Rajesh G.; Chikkali, Samir H., (2024), Thermally Stable P-Chiral Supramolecular Phosphines, their Self-Assembly and Implication in Rh-Catalyzed Asymmetric Hydrogenation, *Chemistry A Europe Journal,*30,45

33 Sharma, Alpa; Govande, Vijaya; Mahajan, Shivangani; Sawant, Sanghapal D., (2024), 2,3-Difunctionalization of quinones: a gold-catalyzed cascade approach for trifluoromethyl-amination or sulfoximination, *Chemical Communications,*60,71*,9598-9601*

34 Naveed, Abdul; Bag, Debojyoti; Sawant, Sanghapal D, (2024), Modular synthesis of unsymmetrical indolyl diketones from ynediones via sequential aza-Michael addition/C-H functionalization, *Organic Biomolecular Chemistry*

35 Sreejan, Ashley; Saxena, Priyanka; Gadgil, Chetan J., (2024), Network motifs exhibiting a differential response to spaced and massed inputs, *Learning Memorary,* 31,7*,a054012*

36 Siakpebru, Odiri K.; Uchagawkar, Anoop; Gurrala, Lakshmiprasad; Bartlett, Jared; Adamson, Piersen; Gorschak, Nicholas; Hassiba, Adam; Niphadkar, Prashant; Bokade, Vijay; Morais, Ana Rita C.,(2024), One-Pot Production of Liquid Hydrocarbons by Catalytic Hydrodeoxygenation of Lignocellulosic Biomass Using Nickel Loaded on Zeolite-Based Supports, *Energy Fuels,*38,14*,13029-13038*

37 Shabana, K. Khadheejath; Narendranath, Soumya B.; Nimisha, N. P.; Venkatesha, N. J.; Sheetal, G.; Sakthivel, A,(2024), Temperature-programmed reduction method for stabilization of the inorganic framework of SAPO-37 materials: promising catalysts for MTBE production, *Chemical. Communications,* 60,66

38 Adsure, Kiran T.; Jagtap, Sumant B.; Newaskar, Shivkumar R.; Kore, Kiran B.; Funde, Adinath M.; Patange, Sunil M.; Late, Dattatray J., (2024), Exploring the synthesis, characterization, electrical, and magnetic behavior of crystalline Ni1-xZnxFe2O4 nanoparticles, *Journal of Material Science: Materials in Electronics,* 35,26,*1714*

39 Mohole, Madhura; Naglekar, Amit; Sengupta, Durba; Chattopadhyay, Amitabha, (2024), Probing the energy landscape of the lipid interactions of the serotonin 1A receptor, *Biophysical Chemistry,313,1E+05*

40 Samal, Pragnya Paramita; Singh, Chandrodai Pratap; Tiwari, Shivani; Shah, Vaishali; Krishnamurty, Sailaja, (2024), Indazole-5-amine (AIA) as competing corrosion coating to Benzotriazole (BTAH) at the interface of Cu: A DFT and BOMD case study, *Computational and Theoretical Chemistry Journal,1E+05*

41 Masal, Dattatraya P.; Reddy, D. Srinivasa, (2024), Gram-Scale Synthesis of (±)-Tylophorine, *Synlett*

42 Kaulage, Sandeep H.; Parvin, Nasrina; Khopade, Kishor V.; Khan, Shabana, (2024), A hybrid silylene-Pd catalyst: efficient C-N cross-coupling of sterically bulky amines and chiral amines, *Chemical Communications, 60,73,9958-9961*

43 Sahu, Umasharan; Prasad, Bhagavatula L. V., (2024), One-pot, easy and scalable synthesis of large-size short wavelength IR emitting PbS quantum dots, *Photochemistry and Photobiology,* 100,4*,1020-1030*

44 Syed, Naziya; Singh, Suman; Chaturvedi, Shivani; Kumar, Prashant; Kumar, Deepak; Jain, Abhinav; Sharma, Praveen Kumar; Nannaware, Ashween Deepak; Chanotiya, Chandan Singh; Bhambure, Rahul; Kumar, Pankaj; Kalra, Alok; Rout, Prashant Kumar, (2024), A sustainable bioprocess technology for producing food-flavour (+)-γ-decalactone from castor oil-derived ricinoleic acid using enzymatic activity of Candida parapsilosis: Scale-up optimization and purification using novel composite, *Journal of Biotechnology,* 393,17*,30*

45 Saharan, Sunita; Ghanekar, Umesh; Shivankar, Bhavana R.; Meena, Shweta, (2024), High-Capacity V2N MXene for Multivalent Ion Batteries: An Ab Initio Study, *Journal of Physical Chemistry , 128,31,12840-12848*

46 Titus, Timi; Vishnu, E. Krishnan; Garai, Arghyadeep; Dutta, Sumit Kumar; Sandeep, Kuttysankaran; Shelke, Ankita; Ajithkumar, Thalasseril G.; Shaji, Anil; Pradhan, Narayan; Thomas, K. George, (2024), Biexciton Emission in CsPbBr3 Nanocrystals: Polar Facet Matters, *Nano Letters,* 24,34*,10434-10442*

47 *B*odawar, Narendra; Shetty, Rohit; Kamble, Sanjay; Kulkarni, Prashant, (2024), Enhanced Degradation of Ciprofloxacin Hydrochloride Using Hybrid Advanced Oxidation Process of Hydrodynamic Cavitation and Ozonation, *Chemical Engineering Technol*ogy

48 Rajput, Parikshit Kumar; Salunkhe, Parashurama; Sarma, Manmayuri; Basu, Meghasree; Gopal, Animesh; Joshi, Aprajita; Shingote, Ajinkya Sundarnath; Saha, Surajit; Rahman, Atikur; Nag, Angshuman, (2024), Entropy-Driven Reversible Melting and Recrystallization of Layered Hybrid Perovskites, *Small*

49 Subhedar, Dnyaneshwar D.; Shaikh, Mubarak H.; Nagargoje, Amol A.; Sarkar, Dhiman; Khedkar, Vijay M.; Shingate, Bapurao B., (2024), [DBUH][HSO4]-Catalyzed Solvent-Free Synthesis of 1,5-Benzodiazepine Derivatives: Bioevaluation and In Silico Molecular Docking Study, *Current Organic Chemistry*

50 Ajithkumar, V. S.; Ghanwat, Pratiksha B.; Saha, Sougata; Pati, Swapan K.; Sen, Sakya S., (2024), Stereodivergent sila-germylenation vs. sila-stannylenation of an internal alkyne, *Chemical Communications,* 60,72*,9837-9840*

51 Shah, Mumtaj; Mesfer, Mohammed K. Al; Nagar, Harsha, (2024), Static and dynamic properties investigation of modified polyethersulfone membrane for direct methanol fuel cell applications, *Journal of Power Sources, 615,2E+05*

52 Damberger, Fred F.; Krepl, Miroslav; Arora, Rajika; Beusch, Irene; Maris, Christophe; Dorn, Georg; Sponer, Jiri; Ravindranathan, Sapna; Allain, Frederic H-T, (2024), N-terminal domain of polypyrimidine-tract binding protein is a dynamic folding platform for adaptive RNA recognition, *Nucleic Acids Research*

53 Singh, Shivangi; Marayathungal, Jumana Hasin; Das, Deep Kumar; Khan, Akram Aadil; Bakthavatsalam, Rangarajan; Hathwar, Venkatesha R.; Kundu, Janardan, (2024), Rational Design of Zero-dimensional Manganese(II) Halide Hybrids with Suppressed Melting Temperatures, *Journal of Physical Chemistry , 128,35,14849-14859*

54 Giram, Prabhanjan S.; Nimma, Ramakrishna; Bulbule, Anuradha; Yadav, Amit Singh; Gorain, Mahadeo; Radharani, Nalukurthi Naga Venkata; Kundu, Gopal C.; Garnaik, Baijayantimala, (2024), Engineered PLGA Core-Lipid Shell Hybrid Nanocarriers Improve the Efficacy and Safety of Irinotecan to Combat Colon Cancer, *ACS Biomaterial Science and Engineering*

55 Javaregowda, Bharathkumar H.; Kargude, Radhakisan; Birajdar, Sarika; Shivankar, Bhavana; Krishnamurty, Sailaja; Jones, Lathe A.; Caruso, Rachel A.; Krishnamoorthy, Kothandam, (2024), Synergistic Effect of Lactam and Pyridine Nitrogen on Polysulfide Chemisorption and Electrocatalysis in Lithium Sulfur Batteries, *ACS Applied Materials and Interfaces,* 16,32,*42059-42068*

56 Deshmukh, Samadhan H.; Yadav, Sushma; Chowdhury, Tubai; Pathania, Akhil; Sapra, Sameer; Bagchi, Sayan, (2024), Probing surface interactions in CdSe quantum dots with thiocyanate ligands, *Nanoscale*, 16,31,14922-14931

57 Gore, Jayram I.; Mahajani, Sanjay M.; Mali, Nilesh A, (2024), Reactive distillation configuration for the production of ethyl acrylate, *Chemical Engineering and Processsing, 203,1E+05*

58 Gopalsamy, Karuppasamy; Singh, Chandrodai Pratap; Krishnamurty, Sailaja; Babarao, Ravichandar, (2024), Metal-Organic Frameworks for Enhanced Hydrogen Generation from Syngas: A Density Functional Theory Approach, *ChemPlusChem*

59 Kumar, Mudavath Arun; Swapna, Bhattu; Kalbande, Pavan Narayan; Yalagandula, Lavanya; Singh, Satyapaul A.; Sudarsanam, Putla, (2024), Selective Synthesis of Renewable Diesel Fuel Precursors via C-C Condensation of Biomass-Derived Furans Using a Niobium Oxide Nanocatalyst, *ACS Sustainable Chemical Engineering*

60 Bag, Debojyoti; Saini, Sheetal; Rathod, Mahesh S.; Sawant, Sanghapal D., (2024) Divergent Synthesis of Unsymmetrical Bis-heteroaryl Ketones via Base-Promoted Cascade Reactions of 1,2-Alkynedione-Derived N-Propargylic β-Enaminones, *Journal of Organic Chemistry, 89,16,11665-11670*

61 Todkari, Iranna Annappa; Chaudhary, Preeti; Kulkarni, Mahesh J.; Ganesh, Krishna N., (2024), Supramolecular polyplexes from Janus peptide nucleic acids (bm-PNA-G5): self-assembled bm-PNA G-quadruplex and its tetraduplex with DNA, *Organic Biomolecular Chemistry,* 22,33,*6810,6821*

62 Salunke, Gayatri; Badhe, Yogesh; Singh, Vrijendra; Ghorpade, Prakash; Hegde, Mahabaleshwar; Kadoo, Narendra, (2024) Molecular insights into the oleic acid accumulation in safflower, *Journal of American Oil Chemists' Society,*

63 Swapna, Bhattu; Singh, Nittan; Patowary, Suranjana; Bharali, Pankaj; Madras, Giridhar; Sudarsanam, Putla, (2024), Efficient glycolysis of used PET bottles into a high-quality valuable monomer using a shape-engineered MnOx nanocatalyst, *Catalysis Science and Technology*

64 Giri, Pritam; Lim, Seonga; Khobragade, Taresh P.; Pagar, Amol D.; Patil, Mahesh D.; Sarak, Sharad; Jeon, Hyunwoo; Joo, Sangwoo; Goh, Younghwan; Jung, Seohee; Jang, Yu-Jeong; Choi, Seung Beom; Kim, Ye Chan; Kang, Taek Jin; Heo, Yong-Seok; Yun, Hyungdon, (2024), Biocatalysis enables the scalable conversion of biobased furans into various furfurylamines, *Nature Communications,* 15,1, *6731*

65 Asokan, Kiran; Bhagyasree, T. M.; Devasia, George; Krishnamurty, Sailaja; Solim, Sabah; Rueda, Lina; Al-Mohannadi, Dhabia M.; Al-Hashimi, Mohammed; Kakosimos, Konstantinos; Santhosh Babu, Sukumaran, (2024), A scalable approach using a gC3N4 -covalent organic framework hybrid catalyst towards sustainable hydrogen production from seawater and wastewater, *Chemical Science,* 15,33,*13381-13388*

66 Tellis, Meenakshi; Mohite, Sharada; Joshi, Rakesh, (2024), Trehalase inhibition in Helicoverpa armigera activates machinery for alternate energy acquisition, *Journal of Bioscience.,* 49,3,*74*

67 Dutt, Shifali; Kottaichamy, Alagar Raja; Dargily, Neethu Christudas; Mukhopadhyay, Sanchayita; Nayak, Bhojkumar; Devendrachari, Mruthyunjayachari Chattanhali; Vinod, Chatakudhath Prabakaran; Kotresh, Harish Makri Nimbegondi; Thotiyl, Musthafa Ottakam, (2024), Switchable molecular electrocatalysis, *Chemical Science,* 15,33,*13262-13270*

68 Rajput, Vinay; Das, Rashmita; Pramanik, Rinka; Nannaware, Kiran; Yanamandra, Sushma; Taji, Nyabom; Rajput, Vishal; Rajkhowa, Riyakshi; Pacharne, Poonam; Shah, Priyanki; Gogate, Niharika; Sangwar, Poornima; Bhalerao, Asim; Jain, Nidhi; Kamble, Sanjay; Dastager, Syed; Shashidhara, L. S.; Karyakarte, (2024) Early detection of KP.2 SARS-CoV-2 variant using wastewater-based genomic surveillance in Pune, Maharashtra, India, *Journal of Travel Medicine*

69 Mohammed, Abdul Khayum; Pandikassala, Ajmal; Sanchez, Pilar Pena; Gaber, Safa Abdullah; Canossa, Stefano; Kurian, Maria; Xavier, Gigi; He, Yao; Gandara, Felipe; Kurungot, Sreekumar; Shetty, Dinesh, (2024), Iron salicylaldehydate conjugated metal-organic framework for quasi solid-state supercapacitor, *Chemical Engineering Journal, 496,2E+05*

70 Gbadamasi, Sharafadeen; Loomba, Suraj; Haris, Muhammad; Khan, Muhammad Waqas; Maibam, Ashakiran; Mousavi, Seyed Mahdi; Mahmud, Sofiu; Thomsen, Lars; Tadich, Anton; Babarao, Ravichandar; Xian, Jian; Mahmood, Nasir, (2024) Breaking the inactivity of MXenes to drive Ampere-level selective oxygen evolution reaction in seawater, *Material Science and Engineering R-Reports, 160*

71 Shekhar, Pragalbh; Kosugi, Kento; Singh, Himan Dev; Kushwaha, Rinku; Rase, Deepak; Matsuzaki, Takumi; Jain, Chitvan; Singh, Piyush; Singh, Yashraj; Vinod, Chathakudath Prabhakaran; Kondo, Mio; Masaoka, Shigeyuki; Vaidhyanathan, Ramanathan, (2024), Resorcinol-Azodianiline Covalent Organic Framework Supported FeOOH Quantum Dot-Catalyzed Electrochemical Ammonia Synthesis under Ambient Conditions, *Chemical Materials, 36,17,8229-8238*

72 Momin, Naeemakhtar; Manjanna, J.; Kobayashi, Satoru; Aruna, S. T.; Kumar, S. Senthil; Ahmad, Tokeer; Nayaka, G. P.; Mubeen, B.; Sabale, Sandip; Kangralkari, Mrunal V.; Keri, Rangappa S., (2024), Reconstituting the microstructural properties and ionic conductivity of copper - doped yttria-stabilized zirconia via mechanochemical synthesis for intermediate-temperature solid oxide fuel cell applications, *Ceramics International,* 50,19*,35178-35192*

73 Varsha, P. V.; Neenu, K. V.; Begum, P. M. Sabura; Hounfodji, Jean Wilfried; Sankar, Sameera; Muraleedharan, Sneha; Kamath, Anjali N.; Ajithkumar, T. G.; Parameswaranpillai, Jyotishkumar; Dominic, C. D. Midhun (2024), Valorization of avocado peel waste: extraction and characterization of cellulose nanofibers for multifunctional applications, *Biomass Conversion and Biorefinery,*

74 Sankar, K. N. Amba; Kesavan, Lokesh; Saha, Bikash; Jyolsnaraj, M. K.; Mohan, S.; Nandakumar, P.; Mohanta, Kallol; Kvarnstroem, Carita (2024), Renewable synthesis of MoO3 nanosheets via low-temperature phase transition for supercapacitor application, *Scientific Reports* 14,1*,20503*

75 Das, Gobinda; Shinde, Dhanraj B.; Melapurakkal, Amrutha; Shelke, Manjusha, V; Garai, Bikash; Bazin, Philippe; Blal, Abdelhafid Ait; Benyettou, Farah; Prakasam, Thirumurugan; Halim, Rasha Abdul; Ibrahim, Fayrouzabou; Sharma, Sudhir Kumar; Varghese, Sabu; Weston, James; Jagannathan, Ramesh; Addicoat, Matthew A., (2024), Synergistic humidity-responsive mechanical motion and proton conductivity in a cationic covalent organic framework, *Chem,10,8*

76 Patil, Suraj S.; Babar, Bapuso M.; Nadargi, Digambar Y.; Shaikh, Faiyyaj I.; Nadargi, Jyoti D.; Sankapal, Babasaheb R.; Mulla, Imtiaz S.; Tamboli, Mohaseen S.; Truong, Nguyen Tam Nguyen; Suryavanshi, Sharad S.,(2024), La-Fe-O Perovskite Based Gas Sensors: Recent Advances and Future Challenges, *ACS Omega, 9,28,29994-30014*

77 Sathe, Balaji Dashrath; Meenakshi, Meenakshi; Murti, Yogesh; Mane, Madhav Shivaji; Pandey, Sarvesh Kumar; Mahajan, Shriya; Rawat, Pramod; Kandhari, Harsimrat; Goel, Kapil Kumar; Dwivedi, Ashish Ranjan; Rathod, S. V, (2024), Development of New N -{4-[(7-Chloro-5-methylpyrrolo[2,1-f] [1,2,4]triazin-4-yl)oxy]-3-fluorophenyl}benzenesulfonamide Analogues: Exploring Anticancer Potential through MerTK Inhibition, *Synlett*

78 Gera, Rahul; De, Puja; Singh, Kundan K.; Jannuzzi, Sergio A. V.; Mohanty, Aisworika; Velasco, Lucia; Kumar, Pankaj; Marco, J. F.; Nagarajan, Kalaivanan; Pecharroman, Carlos; Rodriguez-Pascual, P. M.; DeBBeer, Serena; Moonshiram, Dooshaye; Gupta, Sayam Sen; Dasgupta, Jyotishman, (2024),Trapping an Elusive Fe(IV)-Superoxo Intermediate Inside a Self-Assembled Nanocage in Water at Room Temperature, *Journal of American Chemical Society, 146,31,21729-21741*

79 Jagadish, Kusuma; Rahane, Ganesh K.; Kumar, Boddeda Sai; Borkar, Durgesh R.; Chordiya, Kalyani; Kavanagh, Sean R.; Roy, Anurag; Debnath, Tushar; Kolekar, Sadhu; Kahaly, Mousumi Upadhyay; Mali, Sawanta S.; Pal, Shovon; Gasparini, Nicola; Dubal, Deepak P.; Rondiya, Sachin R. (2024), Interface-Centric Strategies in Kesterite Solar Cells: Addressing Challenges, solutions, and Future Directions for Efficient Solar-Harvesting Technologies, *Small*

Indian Patents
(July - Sept 2024)

1. Chandrashekhar V Rode; Integrated Micro- and Chemo-catalytic Production of FDCA. India 544088. 2024 July 03
2. S Santhosh Babu; Imidazole linked Pyrene based Two-dimensional Polymer for Proton Conducting Application. India 548164. 2024 August 20

Foreign Patents
(July - Sept 2024)

1. Kadhiravan Shanmuganathan; Composite Polymer Electrolyte Membrane with Enhanced Thermochemical and Chemical Stability. Japan 7514864. 2024 July 03

LECTURES

L.K. DORAISWAMY LECTURE

Innovating Energy Solutions in a Net-Zero Future

Through the talk titled 'Innovation Energy Solutions in a Net-Zero Future', Dr. Joshi, addressed the need to reduce carbon emissions to mitigate climate change. He touched upon the fact of rising energy demand (an expected increase of 20% by 2050) and the current energy transition scenario. According to Exxon Mobil's strategic solutions he discussed, all energy resources- conventional and non-conventional are to be leveraged for the transition to cleaner, low-emission fuels to reach the net-zero target. He emphasized the role of policy, addressable market, societal awareness, cost-effective technologies, and repurposing the current energy infrastructure to accommodate cleaner fuels in the so-called energy transition.

He explained in detail the work at Exxon Mobil's Low Carbon Solutions Technology comprising the 4 energy value chains: Hydrogen as a clean fuel, Carbon Capture and Utilization, Biofuels, and Lithium. The ongoing research work and available technologies in these value chains were discussed. A comparative study on the various hydrogen generation methods- reforming, pyrolysis, and electrolysis was a highlight of the Hydrogen value chain. He gave an overview of the technologies on direct atmospheric Carbon Capture to reduce carbon emission and generation of biofuels through vegetable oil, agricultural waste, and woody biomass.

He ended his talk by highlighting the critical significance of collaboration in creating a successful innovation pipeline. The talk was followed by an interactive Question and Answer session with the scientists and students of NCL. Topics like Hydrogen storage challenges, societal acceptance of nuclear energy, carbon capture from oceans, risks involved in the underground storage of captured carbon dioxide, the role of Methane, and possibilities of storing energy in its potential form using non-conventional energy sources were discussed during the session.

Dr. Prasanna V Joshi, Vice President, Low Carbon Solutions Technology at ExxonMobil Technology and Engineering Co, New Jersey, United States, delivered the L.K. Doraiswamy lecture at CSIR-NCL on the 12th of July 2024. This lecture series honors Padma Bhushan Lt. Dr. L.K. Doraiswamy, an eminent chemical engineer, writer, poet, and NCL's fifth director. He is known for his contributions to Organic Synthesis Engineering and chemical process development. In 1988, he was named one of the 10 most distinguished chemical engineers in the world by the McGraw Hill publication in Chemical Engineering.

PROF. K. VENKATARAMAN MEMORIAL LECTURE

My Science journey and where I am now

CSIR-National Chemical Laboratory (CSIR-NCL), Pune, hosted the esteemed Prof. K. Venkataraman Memorial Lecture on September 19. Dr. Mukund K. Gurjar, Chief Scientific Officer and member of the Board of Directors, Emcure Pharmaceuticals Limited, delivered an inspiring talk on "My Science Journey and Where I Am Now."

Dr. Gurjar, reflecting on his 50-year scientific career, began by sharing how his fascination for science began, drawing from his research experiences at Nagpur University and the University of London. He touched upon his Ph.D. work, particularly highlighting his mechanistic studies on the Stobbe reaction. He explained how 3',6'-Anhydro forms more rapidly than the 1,2-anhydro ring due to the influence of neopentyl CH_2OH, providing insights into the structural behavior of the furanose ring.

The lecture also covered a broad range of his contributions, including oligosaccharide synthesis, N-glycan biosynthetic pathways, and synthesis of the cell wall arabinogalactan peptidoglycans of *Mycobacterium tuberculosis*. Dr. Gurjar emphasized the impact of applied science in the pharmaceutical industry, recounting his pioneering research on AZT and its subsequent industrial manufacturing applications. He shared stories of collaboration with various pharmaceutical companies and discussed significant breakthroughs in API development, including key products like S-Amlodipine, S-Metoprolol, S-Atenolol, and Eribulin.

Dr. Gurjar discussed the intersection of academia and industry, focusing on synthesis of peptides synthesis, complex Gd-chelating agents and the importance of chirality in biological activity and the chiral switching approach in Pharma Industry. His experience underscored the dynamic relationship between scientific discovery and real-world application.

DR. B.D. KULKARNI MEMORIAL LECTURE

Development of a microneedle patch for self-administered, long-acting contraception

The lecture was delivered by Prof Mark Prausnitz who hails from the Chemical and Biomolecular Engineering department of the Georgia Institute of Technology, Atlanta, USA. Through his compelling narration, Prof Mark walked the audience through the research conducted by his group toward developing microneedle patch contraceptives. He emphasized their core problem statement of developing a self-administered, low-cost, effective, discrete, and painless solution for avoiding unintended pregnancies.

The microneedles, embedded on a surface are filled with contraceptive drugs. Once the patch is placed on the skin, the needles pierce through the epidermal and dermal layers with the drug being released into the blood. These microneedle patches are made by casting 2 separate layers: one hydrophobic and the other hydrophilic. This is done to incorporate an air bubble between the needle and the patch to enable easy drug administration. The casts after drying are demolded and ready for use. A significant amount of work was also carried out on erecting bubbles through effervescence. Later on, porous elements were introduced instead of bubbles using the dry freezing technique. Later, studies on the pharmacokinetics of the contraceptive were carried out on rats to understand its drug-release action. A survey was carried out at Georgia University on the preferred choice of contraceptive. Majority of women chose microneedle patches as their primary choice. Methods of extrapolating the 1-month drug effect span to 6 months were developed. Some of the prominent challenges in this include: increased needle size due to increased drug capacity, which might be painful when pierced through the skin. Research is being conducted to overcome these challenges.

EVENTS

Hindi Pakhwada 2024

The Hindi Language Fortnight Celebration was organized from 17th to 30th September 2024. Under this, various Hindi competitions like essay writing, general knowledge tests, science seminars in Hindi, poetry recitations, and other related activities were organized to promote the use of the Hindi language. Officers/employees and research scholars of NCL participated in these activities. Dr Sunil Deodhar a famous literary scholar, stage director, and former officer, Akashwani Pune was the chief guest for the award function. He emphasized the rich legacy, culture, and accessibility of the Hindi language, promoting its usage. Hindi Fortnight Committee Chairman Dr. Ashok Giri, and members, Dr. Swati Chadda , Shri Kaushal Kumar, Shri Ramesh Chandra Samanta, Dr. Puneet Kumar Chaudhary, Shri Gati Nayak, and Shri Gopal Mahanta played an important role in the entire event.

Special Swachata Campaign 4.0

As per the GOI directives, the Swachata campaign, the preparatory phase for the special Swachata campaign 4.0 was organized from 16th to 30th September, followed by the implementation phase from 2nd to 31st October. Activities like the tree plantation drive, Shivajinagar railway station cleanliness drive, Swachata awareness session for NCL School students, and a Swachata pledge for staff and students were organized to raise awareness about cleanliness and safety practices.

Roundtable on 'Patenting of Inventions from Biotechnology and Medtech fields'

Under a collaborative initiative between the Office of the Controller General of Patents, Designs, and Trade Marks (CGPDTM) and the Danish Patent and Trademark Office (DKPTO), a roundtable discussion was organized on the topic of "Patenting of Inventions from Biotechnology and Biomedical fields" on 30th August. Hosted by the Intellectual Property Group of CSIR-NCL, the roundtable was attended by over 40 invited candidates. Attendees included officials from all four Indian Patent Offices, examiners from the Danish Patent Office, and representatives from CSIR labs that file intellectual property in the biotech and medtech domains. Participants also included representatives from Pune-based national labs such as ICMR-NIV, NCCS, ICAR-Grape Research Institute, as well as the industrial body ASSOCHAM. Given the increasing number of startups in the biomedical field, entrepreneurs and inventors with patent filings in Denmark, along with representatives from the Atal Incubation Center at IISER-Pune and Pinnacle Industries, which regularly supports such startups, also contributed their insights.

The roundtable concluded with several key takeaways, including the need for clear guidelines on biotech and medtech examination and search practices in the Indian context, identifying technologies open for commercialization by the Indian Patent Office, and further discussions on the requirements for the deposition of biological material in patent applications and the National Biodiversity Authority.

Independence Day 2024

Flag hoisting ceremony at the CSIR-NCL campus on 15th August.

Patents certification workshop

A 2-day workshop on patents for Entrepreneurs, Scientists, and Engineers was held collaboratively by the Intellectual Property group of CSIR NCL and CIPAM, New Delhi on the 5th and 6th of July. This workshop enabled participants to learn about patents, identify and know about protecting their inventions, understand the patenting process sufficiently to engage with and interact with patent professionals, and strategize its commercialization.

FEATURED TECHNOLOGY OF THE QUARTER

Synopsis: *In the quest for sustainable solutions, CSIR- National Chemical Laboratory has developed an end-to-end process for manufacturing sodium and lithium zeolites. This technology has undergone rigorous third-party testing & evaluation and benchmarked against commercial zeolites. This technology promises to advance the field of adsorbents, ion exchangers, and catalysts. With its potential applications in various industries, from medical-grade oxygen production to selective CO_2 adsorption, this new process represents a significant step forward in achieving greater efficiency and cost-effectiveness. This article explores the applications, value proposition, and availability of this pioneering technology.*

Technology Management Group
asktmg@ncl.res.in.

CSIR-NCL's end-to-end Process for Zeolite Synthesis

Introduction:

Zeolite, a material known for its distinct porous structure, holds immense value across diverse industries. Sodium and lithium low silica zeolites are widely applied in processes such as adsorption, ion exchange, and catalysis. These materials can selectively separate and capture specific gases or molecules from mixtures, for example, oxygen from air, and the separation of carbon dioxide from biogas (methane).

Applications for a cleaner future:

Zeolites have wide-ranging applications in refining, petrochemicals, agriculture, aquaculture, building & concrete. Zeolites can also be used in converting biomass, storing thermal energy, capturing & converting CO_2, air pollution remediation, and water purification. The market for zeolites is expected to grow from USD 3.1 billion in 2022 to USD 3.9 billion by 2028, with a yearly growth rate of 3.5% during this period.

CSIR-NCL's zeolite serves two significant purposes: firstly, through the use of lithium low silica zeolite, it produces high-quality medical-grade oxygen, which is crucial for patients in hospital ICUs and persons with breathing difficulties. Secondly, by utilizing sodium-low silica zeolite, it captures CO_2 from biogas and purifies gases, making the utilization of biogas possible and economically viable.

Value Proposition: Introducing an innovative manufacturing process

CSIR-NCL has developed an efficient way of making low silica zeolites that has many advantages compared to the traditional process. One significant improvement is the elimination of the gel aging process, resulting in faster production and energy savings. This process doesn't use binders, resulting in stronger and more stable zeolite particles. With their one-step crystallization technique, they can create zeolites that are 100% pure in just one step, guaranteeing consistent and reliable quality. By optimizing the recovery process, they can reduce waste and make zeolite production more efficient. Additionally, they can precisely control the composition and size of the zeolites, so they can customize them for different uses.

Current status and future outlook:

The manufacturing process for low silica sodium and lithium zeolite has been successfully demonstrated and validated on a lab scale. CSIR-NCL is actively seeking partners in commercializing this technology through licensing and co-development. Industries that partner with CSIR-NCL can benefit from the efficient manufacturing process and contribute to a cleaner and more sustainable future.

In summary, CSIR-NCL's efficient process for making these zeolites presents an opportunity to start local production of these advanced materials in India and not rely solely on imports. CSIR-NCL zeolites outperform commercial alternatives in adsorption and oxygen concentrators, offering exceptional performance. Their applications in medical-grade oxygen production and selective CO_2 adsorption hold promise for a cleaner future. This technology is available for licensing and co-development, presenting a great opportunity for Indian industries to enter this domain. For further information and inquiries, please write to asktmg@ncl.res.in.

MOUs/ MOAs SIGNED (July to Sept 2024)

Sr. No.	Client Name	Title of MoU/ MoA	Project Leader
1	CSIR-CECRI & Periba Hycoco LLP	HTPEM Fuel Cell Stack and Methanol Reformation Studies	Dr. Shreekumar kurungot
2	BAIF Development Research Foundation	Diagnostic for Early Detection of Zoonotic Bovine Infectious Diseases	Dr. Dhanasekaran Shanmugam
3	ITER-India_Institute for Plasama Research	Hydrogen Oxidation at Lab-Scale Catalyst Development	Dr. T. Raja
4	Pune Knowledge Cluster Foundation (PKCF)	Environmental Surveliance for viral pathogens infecting dairy and Poultry Animals	Dr. Dhanasekaran Shanmugam
5	Buzzworthy Ventures Private Limited	To conduct in-depth research on the metabolites and phytoactive compounds present in Indian monofloral and multifloral honeys, focusing initially on Tulsi, Ajwain, and other indigenous floral sources	Dr. Ashok Giri
6	BKL Walawalkar Rural Medical College	Analysis of big data from the Dervan Cohort of adolescent girls. Study of metabolites linked to undernutrition and diabetes via GC-MS; purificationof Jacalin from jackfruit; development of lateral flow immunoassays for progesterone and snake-bite diagnosis; cancer research Project	Dr. Rahul Bambhure
7	Aarti Foundation	To develop approached for decarbonization of Indian chemical industry	Dr. Amol Kulkarni

TECHNOLOGY TRANSFERS

Sr. No.	Company Name	Title	Project Leader
1	Kashtakari Panchayat	3D Printing of Recycled HDPE Waste using FDM (Fused Deposition Modelling) Technology	Dr. Kadhiravan S.

TECHNOLOGIES AVAILABLE FOR LICENSING

Sr. No.	Technology	Sector
1	Continuous catalytic process for the production of 4,4' Bisphenol-A (BPA)	Chemical
2	Novel, Eco-friendly & Autocatalytic process for the synthesis of Tributyl citrate (TBC)	Chemical
3	A patented catalytic process for making Diphenylmethane (DPM)	Chemical
4	Novel process platform for the manufacturing and purification of biosimilar rHu Ranibizumab	Biopharma
5	Novel process platform for the manufacturing and purification of Anakinra	Biopharma
6	Targeted glycosylation modulating process for recombinant proteins (Including monoclonal antibodies)	Biopharma
7	High-yield production of high-value Bacterial Nano Cellulose (BNC) films from low-cost crude glycerol feed	Health
8	Efficient manufacturing process For Na-LSX (13 X) & Li-LSX Zeolite	Specialty materials
9	Continuous process for manufacturing precision Silver Nanowires at scale	Specialty materials
10	Continuous & tunable process for the large-scale synthesis of Mesoporous & Nanoporous Silica	Specialty materials
11	Simple, eco-friendly catalytic delignification process for sugarcane bagasse (SB)	Biomass valorisation
12	Dietary Supplement Formulation of Probiotic Strain for Organic Poultry Production	Agriculture/ poultry
13	Efficient catalytic process & novel reactor design for hydrogen sulfide (H2S) removal from different gas streams	Gas separation
14	Process for the novel thermostable Biosurfactant production	Environmental
15	Efficient recovery process for metals from Spent Li-ion batteries (LIBs)	Environmental

Contact:
Dr. Mangesh Vetal
Head, Technology Management Group,
md.vetal@ncl.res.in (020-2590-2125)

INSTITUTE HONORS

Name of the award
2024 IESA Technology Innovation of the Year Award for the Green Hydrogen category.
Winner of the 8th CII National Energy Efficiency Circle Competition under the "Innovative Clean & Green Technology & Solution Provider" category
1st Runner-Up position at the Green Hydrogen Hackathon (GH2THON) during the 2nd International Conference on Green Hydrogen 2024

FACULTY RECOGNITIONS

Name of Faculty
Dr. V. Koteswara Rao was elected as a Fellow of the Telangana Academy of Sciences (FTAS) for the year 2023

STUDENT ACCOMPLISHMENTS

Award and Event

Miss. Sri Vidya Cherukuthota received the Best Poster Award at the International Conference on 'Materials and Membranes for Water and Energy (ICMMWE 2024)'

Miss. Sanjana Vanessa Almeida received the Best Paper Award in the DAE-BRNS biennial symposium on 'Emerging Trends in Separation Science and Technology (SESTEC-2024)'

Sharmin Percy Kika received the Best Paper Award at the '3rd International Conference on Sustainable Materials and Technologies for Bio and Energy Applications (SMTBEA- 2024)'

Sarika Birajdar received the Best Paper Award at the '3rd International Conference on Sustainable Materials and Technologies for Bio and Energy Applications (SMTBEA- 2024)'

Radhakisan Kangude received the Best Paper Award at the '3rd International Conference on Sustainable Materials and Technologies for Bio and Energy Applications (SMTBEA- 2024)'

Nitin M Thorat received the Best Oral Presentation Award at the 'International Conference on Materials and Membranes for Water and Energy (ICMMWE- 2024)'

Athira S Babu received the Best Poster Award under the theme 'Energy Conversion and Storage' by Energy Advances, RSC in the 'International Conference on Energy and Environmental Materials (E2M-2024)'

Yogesh Kumar received the Best Poster Award under the theme "Environmental Monitoring & Remediation" by Energy Advances, RSC in the 'International Conference on Energy and Environmental Materials (ICE2M-2024)'

Sanjivani Pal received the Best Poster Award at the 'International Conference on Materials and Membranes for Water and Energy (ICMMWE-2024)'

Nikhil Samudre received the Best Poster Award at the International Conference on 'Sustainable Catalysis: Synthesis, Theory and Application (SusCat-STA2024)'

Seerat Amin Lone received the Best Poster Award at the International Conference on 'Sustainable Catalysis: Synthesis, Theory and Application (SusCat-STA2024)'

Dr. Shidheshwar B Ankade received the 'OST-Anthem Biosciences Best Thesis Award for 2024'

Amit V. Gavit received the Best Oral Presentation at the International Conference on 'Global Opportunities for Latest Developments in Chemistry and Technology (GOLD CT-2024)'

Ms. Bagwan Farahanaz received the 'Hindustan Platinum Award for Best Poster Presentation during the National Conference on Catalysis for Energy, Environment & Sustainability (CEES)-2024'

Ms. Nikita Gupta received 3rd place during the Poster presentation at the 'Green Energy: Powering a Sustainable Future International Conference'

Mr. Ajinkya Krushnatray received 3rd place during the poster presentation at the 'Green Energy: Powering a Sustainable Future International Conference'

Scilogy

The month of August saw a new beginning for NCL's science club. The existing science club 'Scilogy' was formally renamed 'Scilogy- the ACSIR Science Club' to include newer objectives under its banner. The club inauguration was conducted on the 1st of August and new members were inducted. Following the inauguration, Dr.G.V.Pawankumar from IISER, Pune, delivered a talk titled: Unconventional Scientists: 3 Examples from the History of Science". This talk traced the unconventional yet fascinating life stories of three well-known scientists, Eunice Foot, CV Raman, and Arthur Ashkin. It highlighted the importance of being extraordinary in the world of the ordinary. The session ended on a zealous note with students and researchers alike indulging in an active discussion with the speaker on various topics related to the history of science.

Right from its inception 2 years ago, Scilogy has always been a club “for the students, of the students, and by the students”. On the 12th of August, the office bearers of Scilogy interacted with the newly joined PhDs during their orientation session. This provided an opportunity for the first years to gain exposure to the events organized by the club and also its dynamics.

One of the main goals of Scilogy is to foster healthy scientist-student interaction and make the students aware of the research activities happening in NCL irrespective of their field of study. An event called Scientist Talk was conducted on 18th of September to introduce the students to the young and emerging scientists on campus. Two prominent young scientists Dr.Varun Natu and Dr. Parveen Goyal presented their respective research and also engaged in an active discussion on the scope and value of their research.

Dr.Varun Natu a battery scientist from the physical and materials division spoke of his work on MXenes in energy storage while Dr. Parveen Goyal a structural biologist from the biochemical division spoke about his research on membrane proteins and crystallography. This session provided students an exposure to new research areas and also an opportunity for interaction.

Ms. Rajalakshmi B
b.rajalakshmi@ncl.res.in
Vice-President, NCL-SciLogy

TECHNOLOGY AND ENTREPRENEURSHIP CLUB

The Technology and Entrepreneurship Club (NCL TEC) at CSIR-NCL has revealed its new logo, reflecting its mission to foster innovation, collaboration, and sustainability.
The logo features:

- **Gear and Wires**: Representing cutting-edge technology and innovation.
- **Two Hands**: Symbolizing a supportive, collaborative environment for PhD students and entrepreneurs.
- **Leaves**: Signifying growth and sustainability.

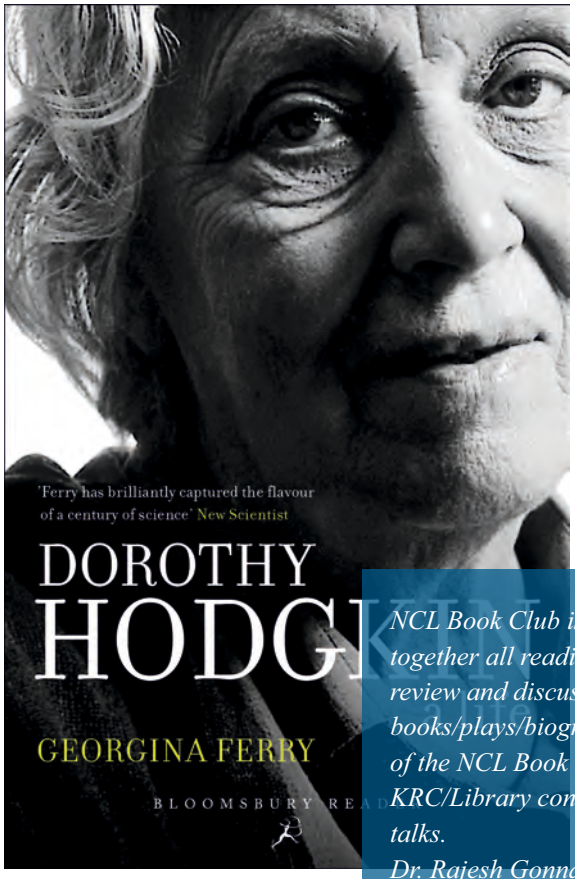
With the tagline **"Innovate. Empower. Grow."** the logo's color palette of **Navy Blue, Teal,** and **Forest Green** embodies trust, modernity, and environmental responsibility, capturing NCL TEC's commitment to driving impactful change.

NCL-TEC
Innovate . Empower . Grow

Recognition for Advancements in Sustainable Energy at International Conference

Ajinkya Krushnatray, President of the NCL TEC - Technology and Entrepreneurship Club at CSIR-NCL, recently won an award for his oral presentation at the **International Conference** ***Green Energy: Powering a Sustainable Future.*** His presentation, titled ***"Scalable and Sustainable Green Transformation of CO_2 using Quantum Dot-Enhanced TiO_2 in Artificial Photosynthesis,"*** highlighted significant advancements in sustainable energy solutions. The conference, organized by the Department of Chemistry and Cluster Research Centre, Government College of Arts, Science & Commerce, Goa, in collaboration with **Ibaraki University, Japan**, took place on September 24-25, 2024.

Mr. Ajinkya Krushnatray
a.krushnatray@ncl.res.in



NCL Book Club is a forum to bring together all reading enthusiasts to review and discuss books/plays/biographies. On behalf of the NCL Book Club, NCL KRC/Library conducts Book Review talks.

Dr. Rajesh Gonnade, Chief Scientist and Head at the Physical and Materials Chemistry Division, CSIR-NCL, reviewed the book "Dorothy Hodgkin: A Life" By Georgina Ferry.

This exceptionally engaging book by science writer and broadcaster Georgina Ferry delves into the life and work of Nobel Laureate Dorothy Crowfoot Hodgkin (1910-1994), a brilliant scientist. In Georgina's own words, this is her first biography, and although she never met Dorothy, it provides a clear understanding of her personal life while making significant breakthroughs in explaining the intricate field of X-ray crystallography. Key sources for the biography include a collection of Dorothy's everyday letters to her husband, Thomas, as well as extensive scientific correspondence, several scientific papers, and three volumes of lectures published by the Indian Academy of Sciences in 1994. Georgina Ferry has used this remarkable archive, long discussions with Hodgkin's talented family, and interviews with crystallographers to write an excellent account of her life. This is impressive in its detail, including information new to those who knew Hodgkin well. The book gives a good account also of the development of the new science of chemical crystallography, much of it by young people. It contains a fine collection of photographs of Hodgkin, her extended family, and the extended families of scientists and peace campaigners she worked with. Dorothy Crowfoot Hodgkin was the only woman from England to ever win a Nobel Prize, which she received in 1964. She was the first woman since Florence Nightingale to be awarded the Order of Merit, the highest honor in the UK. Throughout her career, she received four medals from the Society, including the prestigious Royal Medal, and she remains the youngest woman ever elected as a Fellow of the Royal Society (FRS), achieving this distinction at the age of 36.

Dorothy was born in Cairo, Egypt. She developed a passion for chemistry and crystals at the age of 11. This interest was sparked by a surveyor's kit gifted to her by her father's chemist friend from the Sudan Government, known as "Uncle Joseph." At that time, her father held the position of director of education and antiquities. She began conducting chemistry experiments in the attic of her home, growing crystals from solutions heated with a Bunsen burner beneath the wooden rafters. Gradually the crystals appeared, faceted like jewels, twinkling in the light. Dorothy was enchanted. '*I was captured for life*,' she later wrote, '*by chemistry and by crystals*'. She bore significant responsibilities early on, caring for her three younger sisters while her parents were abroad. Combined with her parents' disappointment at not having a son and her mother's regret for not having been allowed to attend university, these experiences reflect common themes in the lives of high-achieving, hardworking women.

Dorothy attended Somerville College, Oxford, to study chemistry, before moving to Cambridge in 1932 to pursue a Ph.D. in crystallography under the guidance of J. D. Bernal. She described her time with Bernal as "rich with new discoveries," as they explored the boundaries of emerging X-ray diffraction techniques and applied them to biologically significant compounds, including sterols (cholesterol and ergosterol), vitamin D (calciferol) and sex hormones (stilboestrol and some of its derivatives). Less than two years later, she was persuaded to return to Somerville as a Science Fellow and Tutor; however, her collaboration with Bernal continued

informally for the remainder of his career.

Dorothy married in 1937 with Thomas Hodgkin and had three children (a daughter, Elisabeth Hodgkin and two sons (Luke Hodgkin and Toby Hodgkin), within seven years, requiring her to balance her work and family life with the support of their extended family, as Thomas was away in northern England and later in Africa. Hodgkin delighted in the structural patterns in crystals. She was blessed with an excellent memory, so important for a chemist. It contributed to her famous insight or intuition for discerning the molecular structure producing the pattern of spots of the x-ray diffraction picture. Dorothy's triumphs, the structures she solved, increased in complexity: from cholesterol and vitamin D to penicillin and vitamin B-12, the active principle in liver, cure for pernicious anemia. She received the chemistry Nobel Prize in 1964 for the structure of B-12 "and other molecules of biological significance." Some of the molecular structures, in penicillin and vitamin B-12 for example, were quite surprising. Her final triumph, after many years of toil and surprises, was the structure of the essential protein, insulin.

When Perutz and Kendrew shared the Nobel Prize in Chemistry in 1962 for their groundbreaking work in solving the crystal structures of hemoglobin and myoglobin, respectively, Perutz expressed embarrassment at receiving the prize before Dorothy Hodgkin, who was regarded as doyenne of X-ray crystallography.

Due to her left-wing politics the U.S. government denied her a visa in 1953, similar to the restriction placed on Linus Pauling when he sought to travel to Europe. Beginning in 1976, she served as president of the Pugwash Conferences, where scientists united to campaign against nuclear and chemical weapons, sharing information they had collected. She later became active in SANA (Scientists Against Nuclear Arms), which eventually evolved into SGR (Scientists for Global Responsibility).

Margaret Thatcher was one of Dorothy Hodgkin's students at Somerville College. In 1970, while serving as Chancellor of Bristol University, Hodgkin wrote to Thatcher to express concern over cuts to university funding and student grants. Thatcher responded warmly, saying, "Please do get in touch if you want to have a talk ... I do so value your advice and guidance." Later, in 1983, Thatcher invited Hodgkin to lunch at Chequers, where Hodgkin prepared notes for the meeting. Her advice to Thatcher included a suggestion: "Objective: to reconsider relations with the Soviet Union on the premise that friendship is possible and mutually beneficial—across trade, science, art—everything."

My opinion of the book is that it is a bit tedious due to its heavy focus on scientific details and the political aspects of Dorothy Hodgkin's research. However, her life was undeniably fascinating. The book is certainly worth reading to learn about her remarkable achievements.

(a) Dorothy Crowfoot Hodgkin with models and crystallography images of the molecules (Penicillin, Vitamin-B12, Cholesterol, and Insulin) she studied, (b) Dorothy Crowfoot Hodgkin with chemist and peace activist Linus Pauling, 1957.

Dr. Rajesh Gonnade
rg.gonnade@ncl.res.in

Capacity Building

Recognizing the need for a skilled and high-quality workforce relevant to current and emergent industries, CSIR-NCL has implemented a Skill Development Program under CSIR's Integrated Skill Development Initiative programs. These specifically designed and expert-led courses have been offered to for the unemployed graduate and postgraduate, industry staff and workers, scientists, inventors, etc. for their upskilling.

During this quarter, 5 courses were conducted which were attended by 88 participants.

Quality control Chemist (1st July to 12th July)

The course began with an understanding of basic chemistry concepts and industrial safety guidelines. Further, it included demonstration and hands-on training in various chromatographic techniques like HPLC, GC, GCMS, GPC, and mass spectrometric techniques. The participants were informed about topics like USFDA protocols, method development, Qualitative and Quantitative assessments, validation, and troubleshooting. The importance of Good Documentation Practices (GDP), Standard Operating Procedures (SOPs), and Good Laboratory Practices (GLP) was also conveyed during the course.

Advanced characterization techniques (29th July- 30th August)

A hands-on training in techniques crucial to characterization in research and industry like spectroscopy (UV-Vis, IR, Raman), electron microscopy (SEM, TEM), thermal analysis (TGA, DTA), Magnetic measurements (VSM, SQUID), and X-ray techniques (crystal XRD) was provided to the participants during this course.

Mass spectrometry and proteomics (1st August to 30th September)

This course provided an introduction to various technologies related to proteomics including peptide mapping, protein identification, characterization of post-translational modification, quantitative proteomics approaches like iTRAQ, SILAC, SWATH, MRM, and PRM, etc.

Chromatographic techniques (26th August to 13th September)

Chromatography, being a crucial technique extensively employed in industry and research to facilitate quantitative and qualitative analysis, this course encompassed comprehensive training on various chromatographic techniques like GC, GC-MS, HPLC, and HPLC-MS.

Synthetic Organic Chemistry (9th September to 30th December)

This course encompassed areas in organic chemistry like organic transformation and execution of multistep synthesis. The training involved setting up the reactions under direct guidance, reaction monitoring, product isolation and purification, and analysis of the product(s) formed. Topics like safe practices with laboratory chemicals, literature data mining, analytical data processing, and proper record-keeping were also covered.

GLOBAL CONCLAVE ON PLASTIC RECYCLING AND SUSTAINABILITY (GCPRS 2024)

GCPRS 2024 was a first-of-its-kind exhibition on plastic recycling in India held from the 5th to the 8th of July at Bharat Mandapam, New Delhi. About 250 companies across the globe had their stalls during this conclave. CSIR team from NCL Pune (Drs. Samir Chikkali, Harshwardhan Pol, Nikhlesh Yadav, and Prashant Patil), CEERI Chennai (Dr. Madan, Mr. Arvind Kumar) and IIP Dehradun (Drs. Sanat Kumar, Ajay Kumar, Rajaram Bal, Bipul Sarkar, Indrajit Ghosh, Rana) demonstrated the outcome of the DEPOLUP project. This CSIR mission mode project is aimed at addressing the societal problem of plastic menace and providing scientific solutions. The project has made significant progress on several fronts. In a proof-of-concept study, CSIR-NCL developed a process to decontaminate waste PPE kits (personal protective equipment mainly containing non-woven PP) and demonstrated the fabrication of several items such as automobile parts, agricultural pots, etc. Along with partner industries, the process has been scaled up and trials were conducted on a 100 kg scale. This process has been licensed to a start-up company. CSIR-CEERI team has developed technologies to segregate waste flexible/hard plastic at a rate of about 150-200 kg//h. The technology relies on NIR-based detection, coupled with AI-based decision-making and segregation. The segregation unit is being integrated with 1 TPD pilot plant for waste plastic to diesel (BS-VI) at IIP Dehradun. The IIP plant catalyst has been improved from 24 hours of catalyst life to now about 100 hours. The new catalyst will allow the IIP "waste plastic to diesel" plant to run for about 100 hours and enable further commercialization efforts. The increased lifetime of the catalyst will allow the team to take long trials and assess the techno-economics of the process, and elevating it from TRL 6 to TRL 7. In the downstream processing, the pyrolysis oil produced by the local "plastic to oil" plants is being upgraded. In this, three approaches have been attempted, namely, hydrotreating, hydrogenation, hydrodesulfurization (HDS) and plastic naphtha to BTX (benzene, toluene and xylene). The hydro treating and HDS have been scaled up to a few hundred-gram scale and further scale-up is in progress. As a long-term target, the mission project has undertaken research to convert waste PE and PP into value-added, upcycled, products. The waste polyethylene is converted into long-chain alkenes such as dodecene, waxes and detergents. These are upcycled, value-added products of high commercial significance. However, these efforts are at the lab scale and further work is necessary. Patents have been filed on several aspects of the outcome.

The team got the working models fabricated for demonstrating CSIR technologies in an exhibition like GCPRS which is generally dominated by industry. Several industrialists and dignitaries visited the CSIR booth and appreciated the performance of DEPOLUP. New contacts were established and potential options for collaboration/tech-transfer were explored. The CSIR booth at the exhibition is the first of its kind and will catalyze industry collaborations in the near future.

Training program for educators and administrators

On the 3rd of July, a group of 137 school Director, Principals, and Teachers from various parts of Maharashtra, attended a full-day, Continuous Professional Development (CPD) training program organized by NCL for educators and administrators in association with "Knowledge and Awareness Mapping Platform (KAMP)", an alliance and initiative of CSIR-NIScPR, New Delhi. The training program included talks by various scientists from NCL and discussion sessions.

Teacher mentoring workshop

A group of 26 teachers from different regions of Maharashtra participated in a brainstorming 'Teacher Mentoring Workshop' held from 24-25th July 2024. Junior college science teachers from Pune, Sangali, Nanded, Kolhapur, and Dhule participated in the workshop. This was organized as a part of CSIR-JIGYASA in collaboration with the Muktangan Exploratory Science Centre (MESC), Pune.

in News

CSIR-NCL CELEBRATES THE NATIONAL TECHNOLOGY DAY

CSIR- National Chemical Laboratory (CSIR-NCL), Pune, celebrated the National Technology Day on Tuesday, 21st May 2024. The highlight of the celebration was the keynote address by Mr. Subramani Ramachandrappa, Founder and Managing Director of Fermbox Bio Pvt. Ltd., Bengaluru. Mr. Ramachandrappa delivered an inspiring talk on "Science and Entrepreneurship," where he shared his journey and the challenges and triumphs of being involved in entrepreneurship.

Dr. Ashish Lele, Director, CSIR-NCL, opened the event with a warm welcome and a brief overview of the importance of National Technology Day. He emphasized the critical role of translating technology and its commercialization, describing it as a long journey with many milestones but no endpoints. This journey, he noted, requires a great deal of patience, yet it is enjoyable. He encouraged all his colleagues and students to engage in this process. Dr. Lele also highlighted this year's theme for National Technology Day: "From Schools to Startups: Igniting Young Minds to Innovate."

Mr. Subramani Ramachandrappa delivered an insightful lecture addressing various crucial aspects of science and entrepreneurship. He began by discussing the inherent challenges in developing scientific ideas and how innovation plays a pivotal role in overcoming these obstacles. He emphasized that there are many ideas from which some innovative ideas will hatch evolving from initial concepts into fully realized visions. He highlighted the importance of maintaining confidentiality and protecting intellectual property (IP) to ensure that innovative ideas remain secure and commercially viable.

Mr. Ramachandrappa stressed the significance of mentorship and family support as the major pillars essential for success. He highlighted that a successful entrepreneur should never give up, suggesting they

DR. ASHISH LELE FELICITATES MR. RAMACHANDRAPPA WITH A MEMENTO AND A SOUVENIR

हिंदी तात्कालिक भाषण प्रतियोगिता का आयोजन

मनन-चिंतन का अवसर

राजभाषा ने किया सभी को एकत्र

प्लास्टिकच्या पुनर्वापरासाठी 'एनसीएल'चे संशोधन

पायरॉलिसीस प्रकल्पाची उत्पादकता वाढविणार; सुचविले महत्त्वपूर्ण बदल

महत्त्वाचे निष्कर्ष...

'एनसीएल'ने सुचविलेले बदल

'एआय' आधारित विलगीकरण

'एनसीएल'मध्ये मिनी मंडेल

आकडे बोलतात...

१३०९ मेट्रिक टन

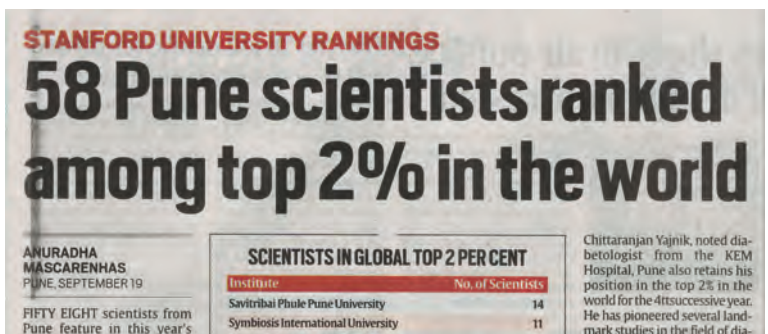
पुण्यात दिवसाला निर्माण होणारा घरगुती कचरा

३७ टन प्रतिदिन

पुनर्वापर होणारा प्लास्टिकचे प्रमाण

९९ टन प्रतिदिन

यातील प्लास्टिकचे प्रमाण



STANFORD UNIVERSITY RANKINGS

58 Pune scientists ranked among top 2% in the world

ANURADHA MASCARENHAS
PUNE, SEPTEMBER 19

FIFTY EIGHT scientists from Pune feature in this year's Stanford University rankings list of top 2% of scientists in the world. These include 14 from Savitribai Phule Pune University (SPPU), 11 from Symbiosis International University (SIU), 12 from National Chemical Laboratory (NCL), 9 from Inter-University Centre for Astronomy and Astrophysics (IUCAA), 4 from Indian Institute for Science Education and Research (IISER) Pune, 4 from DY Patil Vidyapeeth, 1 from Pulmocare Research and Education (PURE) Foundation, 1 from KEM Hospital, 1 from Armed Forces Medical College and 1 from College of Engineering Pune (COEP).

On September 17, Stanford University released the list that includes 22 scientific fields and 174 sub-fields. The Stanford University ranking identifies the world's top scientists based on standardised citation metrics offering a reflection of the most influential researchers globally. Out of the 2,23,252 scientists in the top 2% in the world from across all fields, India has 5,352, up from 4,635 in 2023.

When contacted, Dr Ramakrishnan Raman, Vice-Chancellor, Symbiosis International (Deemed) University said the prestigious achievement underscores the varsity's commitment to foster excellence in research and interdisciplinary innovation. "As the Vice-Chancellor, I am immensely proud of the recognition that 11 faculty members are in the global top 2 percent scientist rankings. We are also supported by dedicated faculty members who strive for academic excellence," Dr Raman told The Indian Express. Dr Vidya Yeravdekar, Pro-VC, SIU said this achievement showcases the exceptional work being done by the institution towards impactful research.

Dr Sundeep Salvi retains the number 1 Respiratory Scientist in India for the 4thyear in a row and has also jumped his global ranking from No. 50 in 2023, to number 35 in the world this year out of 65,702 global respiratory scientists. "It is good to see Pune on the world map of lung research," Dr Salvi said. Dr Chittaranjan Yajnik, noted diabetologist from the KEM Hospital, Pune also retains his position in the top 2% in the world for the 4ttsuccessive year. He has pioneered several landmark studies in the field of diabetes which are recognized worldwide.

When contacted, Dr Yajnik told The Indian Express that their research on the developmental origins of health disease (DOHaD) offers hope for future generations that good nutrition and healthy lifestyle of young girls in the society will help break the curse of intergenerational programming of diabetes and cardiovascular disease in Indians. "We had a good year with path-breaking findings and it will help policy makers do right things for the right reasons," Dr Yajnik said.

At IUCAA, Professor Surhud More said that the large number of scientists from Pune in the list underscores not only the volume but also the quality of the science research activity happening in Pune in various scientific fields.

The Stanford University annual rankings are a widely recognised source of global rankings of the top 2% scientists in the world.

SCIENTISTS IN GLOBAL TOP 2 PER CENT

Institute	No. of Scientists
Savitribai Phule Pune University	14
Symbiosis International University	11
National Chemical Laboratory	12
The Inter-University Centre for Astronomy and Astrophysics	9
DY Patil University	4
Indian Institute of Science Education and Research, Pune	4
KEM Hospital	1
Armed Forces Medical college	1
COEP Technological University	1
Pulmocare Research & Education Foundation	1

Researchers develop nanocomposite for wearable devices

The Hindu Bureau
BENGALURU

Researchers from the Bengaluru-based Centre for Nano and Soft Matter Sciences (CeNS) with scientists from the National Chemical Laboratory (CSIR-NCL) developed a new piezoelectric polymer nanocomposite material that can be useful for pressure-sensing and energy-harvesting applications.

"In today's world, energy creation and harvesting from readily available sources is crucial. Mechanical energy can be transformed to electrical energy through a variety of techniques, including piezoelectric effect. Flexible, portable, sustainable, and wearable sensors and energy harvesting devices are critical nowadays. Polymers and nanoparticles play a major role in present flexible electronic systems," said the Department of Science and Technology.

The researchers synthesized two zirconia-based metal-organic frameworks (UiO-66 and UiO-67), which were converted to zirconia nanoparticles with exquisite control over their crystallographic phases namely monoclinic and tetragonal phases.

Furthermore, a demonstration of a wireless, Bluetooth-based security alert system supported by an Android application was carried out using the fabricated prototype as an energy-generating and security alert pavement unit.

STARTUPS FROM CSIR-NCL

Number of Startups Created-14

Number of Scientists Involved-11

Sectors: Health, Sustainable materials, Energy

OrthoCrafts

Excellence in Bioabsorbable Implants

SERIGEN

Nextgen Tissue Regeneration Products- Powdered by Silk

MODULE INNOVATIONS

Rapid Diagnostics that Fit Your Pocket

ZeroPlast

Circular Economy of Single-use Packaging

Rechargion

Novel Rechargeable Batteries

GENRICH Membranes Pvt. Ltd.

Membrane Based Innovative Technology

vivira

Vortex Diodes for Industrial Wastewater Treatment

GREEN PYRAMID BIOTECH PVT LTD

Excellence in Cleaning Agriproducts

BARE FEET ANALYTICS

Food Testing Solutions

ABHIRUCHI PROBIOTICS
Your Health our Interest

Novel Probiotic Food Additive

ANNWESON SCITECH

Rapid and Point-of- care TB Diagnostic Kit

FLUOROGENT ANALYTICS

Advanced Diagnostics

ahaMMune

Targeting Skin Immune System

BIOPORE™
ISO 13485 : 2016

Cranio-maxillo-facial surgery

सीएसआईआर - राष्ट्रीय रासायनिक प्रयोगशाला, पुणे
CSIR - NATIONAL CHEMICAL LABORATORY, PUNE

The CSIR - NCL founded in the year 1950 has contributed significantly to the growth and development of the Chemical industry in India. It has partnered research with some of the largest companies in the world. Many of the processes and products that have come out of CSIR-NCL have been successfully commercialized by the industry for domestic consumption and exports.

CSIR-NCL serves sectors such as

- Advanced Materials
- Clean Energy & Environment
- Sustainable Chemical Industry
- Drugs & Pharmaceuticals
- Chemical & Polymer Engineering

Thematic research roadmap

The roadmap aims to leverage the laboratory's scientific excellence and passion for translation along with key stakeholder connects to develop technologies for public, private, societal and strategic goods.

Central Analytical Facility (CAF)

A sophisticated analytical facility that hosts an array of state-of-the-art analytical equipment. It is dedicated to providing high-quality research and technical services, along with expertise and guidance to its users

Microscopes
Confocal, AFM, Fluorescence SEM, ESEM, FESEM, TEM, EDX, HRTEM

Thermal Analyzers
TGA, DTA, DCS, DMA, TMA, STA, SDT

Chromatography Equipment
GC, GC-MS, LC-MS, MS-TOF, MALDI-TOF-MS, GPC, HTGPC, HDMS, FPLC, HRMS

BET and magnetic measurement facility
VSM, SQUID, PPMS

Biochemical Characterization
Genetic analyzer, microinjection system, SPR, FPLC

Spectrometers
UV-Vis, IR-NIR, Time-Resolved IR, Raman, Fluorescence, CD, XPS (ESCA)

X-ray Facility
Variable temperature powder and single crystal XRD, XRF, SAXS, WAXD

NMR
200 MHz (H, C), 300 MHz (Solid State-Multinuclear), 400 MHz (Solution-Multinuclear), 500.13 MHz (Solution & Solid State - Multinuclear.

National Centre for Industrial Micro-organisms (NCIM)

A national facility and microbial culture repository dedicated to isolation, preservation and distribution of authentic and industrially important microbial strains. Over 5000 microbial cultures of bacteria, fungi, yeasts and algae are available for commercial utilization.

Skill Development Program (SDP)

Short module-based, hands-on certification courses in industrially significant technologies, instrumentation techniques and research tools for graduates, postgraduates, industry workers, staff, and unemployed youth who possess suitable educational qualifications but still struggle to find employment

Contact us

Dr. Homi Bhabha Road, Pune- 411 008 (INDIA)
डॉ. होमी भाभा रोड, पुणे (भारत)-411 008

www.ncl.res.in
director@ncl.res.in
@csir.ncl @csir_ncl @nclpune
@csir-national-chemical-laboratory

Credits: Dr. Nikhlesh Yadav (PSC Unit)

CSIR-National Chemical Laboratory

Compiled and Published by
Publication and Science Communication Unit,
CSIR-NCL
Phone: 020-2590-2034
Email: allotrope@ncl.res.in

Catalysing Innovation

CSIR-National Chemical Laboratory
Dr. Homi Bhabha Road, Pune 411 008 (INDIA)
Email: director@ncl.res.in Website: www.ncl.res.in
Facebook:@csir.ncl Twitter: @csir_ncl

All rights of this magazine are reserved with the CSIR-National Chemical Laboratory, hence, reproducing, distributing, printing, or creating derivative works without permission of the concerned authority is strictly prohibited.